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SCIENCE AND THE BIBLE;

OR, THE

MOSAIC CREATION AND MODERN DISCOVERIES.

BY

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PREFACE.

TWO great Volumes have been laid before man for his instruction, and from which his ideas and science all have been derived—the material Works, and the inspired Word of God. These being the productions of the same wise and unchangeable Author, the harmony subsisting between them is universal and complete. Both have for their end the manifestation of the invisible Deity. While in the Bible we have a *verbal* revelation of the wisdom and power and goodness of God, in material Nature we have a *pictorial* revelation of the same, "the invisible things of Him being understood by the things that are made, even his eternal power and Godhead."

Though both these revelations date from a period far back in the past, yet each retains, after the lapse of all the ages, its original interest and freshness undiminished. The Bible, though the oldest of books, is confessedly ever new and delightful to those who have been taught to enter into its spirit. The expanded pages of Creation, likewise, present us with a study that is as marvellous and attractive now as it was six thousand years ago. We of to-day discover as much to admire in the "great deep," in "the precious things of the everlasting

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hills," in the overspreading vegetation, and in the living tenants of the earth, as did Adam when he walked forth to survey the beauties of Eden while arrayed in the glitter of its earliest dews. Neither the wealth of meaning, nor the depth of interest, treasured up in these divine volumes, will ever be exhausted.

In the following pages the study of these two books is combined; and the main design of the Writer, while all along indicating their harmony, is to illustrate the inspired Record of Creation by the marvellous developments of modern science in the various departments of Nature—to bring before the Reader, from among the abounding materials of each Day's work, such objects and scenes and agencies as present striking displays of the omnipotence, wisdom and beneficence of the Creator, and convincing evidences of his universal presence and unremitting agency. Such a presentation of the phenomena of nature in elucidation of the sacred Word, it is believed, will be found by every reflecting person, not only deeply interesting as a study, but also in the highest degree calculated to expand the views, enlighten the judgment, and improve the heart. In thus devoutly studying the Word of God in connection with his wonderful works, we discover the conceptions and plans, the reasonings and purposes, of God; and, to the extent of our capacity, His mind becomes our mind, and His science our science. The more we investigate what He hath done, the more shall we know of Him, and the more we shall admire what we know, and love what we admire.

In regard to the scientific illustrations offered, it may be proper to state, that the Author entered nearly every quarry

within his reach that promised materials suitable to his purpose, and fashioning them after his own plan, inserted them in the edifice rearing under his hands. Anxious, however, to profit all classes of readers, he has, in general, abstained from the more abstruse refinements of science, and, as far as practicable, from the use of learned technicalities; he feels assured, however, that the work on this account will prove none the less interesting or profitable to those who may chance to be familiar with both. Great pains have been taken to obtain the latest and most accurate results of science in every department of the subject.

H. W. M.

ROCHESTER, N. Y.,
January, 1871.

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SCIENCE AND THE BIBLE.

READER, suppose that, by some concurrence of circumstances, you were unexpectedly landed upon a foreign shore, and among unknown people, where you presently discover, among other wonders, a stately temple, magnificent in its elevation and proportions, and venerable for its hoary antiquity. You approach the time-worn steps of its door-way, and are permitted to enter. With deep and solemn interest you advance, step by step, viewing and admiring its several parts—its arches and windows, its altars, statuary, and paintings. Delighted and astonished at the symmetry and beauty everywhere exhibited, you now turn to your attendant, and make many inquiries as to the uses and ends of what you have seen—the meaning of the emblems, the subjects of the paintings, and the grand purpose of the whole edifice. Finding all things most happily adapted for their several ends, and the whole fabric presenting a display of surpassing genius in contrivance, and skill in execution, your admiration is now raised higher than ever, and your reflections are

involuntarily and at once carried back to do homage to the master spirit, the noble architect, in whose creative mind the whole majestic pile had been conceived, and by whose plans and directions its erection had been begun, carried on, and completed. Well, this is not a mere imaginary representation, but all a sober statement of fact; for into such a temple, but one infinitely more wondrous, you have actually been introduced. What structure of man's rearing or contrivance can compare with that of the world into which you have been born? What length and breadth and solidity of foundations have we here! How magnificent its overarching heavens and inextinguishable luminaries! What grandeur in its naked rocks and towering mountains, in its heaving oceans and flowing rivers! How full of charms its varied sceneries! What richness in its living and verdant carpeting! What ceaseless and happy activity among its myriad tenants in every habitable part! How inimitable the music softly echoing in its groves and dells! How solemn and sublime the anthems rolling through its heavens! Here, then, are displays of strength and skill and taste, worthy your most ardent study and admiration. And it is to an examination of this temple of Divine contrivance and workmanship that you are now invited; and I venture to promise you, that, at every step we shall take together, whether through its vaults and crypts, or over its varied and living mosaics, or among its solar and astral lights, we shall find matchless

wonders of wisdom and power and goodness everywhere displayed. If, in the puny productions of man, we can see sufficient to awaken our curiosity and admiration, *here* we shall discover enough to call forth our profoundest adoration. And I cannot but believe, dear reader, whatever thus far your creed or your practice may have been, that ere we shall close the survey now proposed, we shall often together "rise from nature to nature's God," and even *these* magnificent wonders fade from view in our admiration of the Divine perfections from which they have emanated, and by which they are all infinitely transcended.

The Beginning.

Origination of Matter: Primordial condition of the Earth; its pre-Adamite revolutions.

THE BEGINNING.

GENESIS 1 : 1.—In the beginning God created the heaven and the earth.

THUS opens the Book of God with the announcement of a truth which no process of reasoning could have reached, and with the declaration of a fact which no philosophy could ever have unveiled. Nothing can exceed the grandeur of the thought, nothing surpass the appropriateness of the words, as an introduction to the sacred volume. Looking back across the wide waste of all the ages past, this sentence of divine sublimity, like a majestic ARCHWAY, stands at the closing bounds of eternity past—beyond it are the silence and darkness of ancient night; and out of it issue the periods, and scenes, and events of time.

This first verse of the Inspired Record stands as a distinct and independent sentence; and by it the Holy Spirit affirms that the heavens and the earth were "created," or primarily originated by God, not from elements previously existing, but from nothing. Here is asserted the *absolute origination* of the materials composing the universe. This creative act was quite distinct from, and long anterior to, the acts included in "the six days," and which begin with the emergence of light from darkness, at the *third* verse.

The earth and the heavens, then, had a "beginning." Such is the first great truth taught us in the Bible—a truth which the unaided wisdom of man failed to discover or even conceive. The ancient schools of philosophy, without an exception, held that matter was eternal. To them it appeared an absurdity to suppose that anything could be *created* or produced from nothing. "Know first of all," said Epicurus, "that nothing can spring from nonentity." Plato declared matter to be "co-existent with God." And Aristotle asserted the eternity of the world both in matter and form. Nor has this doctrine of the ancients been without its advocates in modern times, some of whom have maintained, not only that the globe itself has been eternal, but also that there have existed upon it an eternal series of men, of beasts, of birds, etc. But the history before us affirms that the earth, and all things therein, were *created* by God, and had a *beginning.* And to a beginning, indeed, all things around us, above us, beneath us, obviously carry us back.

That the earth, its vegetation and living inhabitants have not always been—have not existed from eternity—is proved by this general argument: Order, design, and adaptation of means to ends, universally prove the agency of intelligence; the earth and its productions everywhere abound with instances of order, design and adaptation; therefore, the earth and its productions must be the work of an intelligent Being, and, consequently, must have had a beginning.

Examination, comparison and analysis, in whatever department or province of creation made, on the principle of the above syllogism, carry us straightway back to a beginning. Neither the earth, nor anything on the earth, is found to be *simple* or uncompounded. Everything we see, feel or handle, is a composition—a mixture of different elements. The bodies of animals and the substance of plants, the soil and the rocks, and even the water, the air, and the light are compounds. Now, scientific investigation has ascertained that there are in nature fifty-four simple substances, or elementary principles, and that everything embraced in the substance, or existing upon the surface of the globe, is a composition of a greater or less number of these. As all the words in the English language are composed out of the twenty-six letters of the alphabet, so out of these fifty-four simple substances the whole volume of creation is composed. And as the letters are combined in a definite order to form each word, so these elementary principles are combined in uniform and established proportions, to form the various materials which go to make up our world. The elements composing its atmosphere and its water, the combinations that constitute the crystals composing its rocks, and the angles and facets which the minutest of these exhibit, are so far from indicating the fortuitous result of accident, that they are disposed according to laws the most undeviating, and in proportions mathematically exact. But uniform laws, undeviating order, and exact proportions,

must be the products of an intelligent Being. The atmosphere, the water, and the rocks, therefore, must be the work of such a Being, and, therefore, must have had a beginning. The ancient Atheistic theory of a fortuitous concourse of atoms is thus completely exploded.

Nor do we lack evidence to prove that the above fifty-four elementary substances *themselves* had a beginning. The ultimate and indivisible atoms composing each of them are endowed with properties that have reference and adaptation to those of the others—properties that qualify them to attract or repel, to unite or coalesce with those of the others, so as to produce the endlessly diversified combinations and organisms of nature. These properties in the molecules of each primary element are fixed and definite, both in their number and action. "I assert, without fear of contradiction," says Prout in his famous Treatise on Chemistry, "that the molecular constitution of matter is decidedly artificial." And Sir John Herschell asserts that "every molecule or atom of matter has all the characters of a manufactured article;" consequently, *no atom* can have been eternal. Hence appears the falsity and baselessness of the Pantheistic theory, that would substitute an *eternal nature* for an eternal God—every particle of matter in the universe, in clear and emphatic voice, pronouncing its condemnation.

But to insist no longer on these refinements of science, interesting and conclusive as they are, and to deal only with what the eyes of all can see, and their hands

handle, let us take our stand on the *granite rock*, the basis of the earth's crust—even this is a compound, being made up of quartz, felspar, and mica. Whatever theory we may adopt to account for its origin, granite must have preceded stratified rocks, for these, as is evident and universally admitted, were originally formed out of its pulverized crystalline particles; and *stratified rocks* must have preceded the soil, which is composed out of them and rests upon them; and the *soil* must have preceded vegetation, for this grows out of it; and vegetation must have preceded animals, as these subsist upon it, no living thing being capable of extracting its food directly from the ground. Hence, all animals, all vegetation, all soils, and all stratified rocks must have had a beginning; for each of these has derived its existence from what was in being before it. It plainly appears, therefore, that the Infidel's eternal series of men, of animals, of plants, etc., must have been simply impossible.

GEOLOGY also brings from the depths beneath other testimonies, strong as the rocks, that the whole system of visible things on earth had its beginning. "Every step in our descent through the solid crust of the globe," says Dr. John Harris, "is suggestive of a beginning; for everything speaks of derivation. Each rock points downward to its source, and we can trace the lineal extraction of each successive stratum." And Hugh Miller, speaking of the more ancient animal organizations, says: "Each of the extinct groups, we find, had

a beginning and an end; there is not, in the wide domain of physical science, a more certain fact; and every species of the group which now exists had, like all their predecessors on the scene, their beginning also. The infinite series of the Atheists of former times can have no place in modern science: all organic existences, recent or extinct, vegetable or animal, have had their beginning. There was a time when they were not. The Geologist can indicate that time, if not by years, at least by periods, and show what its relations were to the periods that went before, and that came after."

Astronomy, likewise, reads to us from the heavens a geometrical demonstration of this fundamental truth. The solar system is a magnificent clock-work of unfailing perfection. All its stupendous parts influence and are influenced by one another, yet all move on in absolute harmony. Every orb has its magnitude set off by a scale, its materials weighed in a balance, its distance measured by a line, and its velocity regulated by an infallible law. And in this celestial machinery our planet has its place, fitting therein as a wheel into a wheel in the works of a chronometer. A mere glance at this wonderful system instantly lodges a conviction within the mind, that it is the contrivance of infinite skill, and the work of infinite power, and, consequently, that there was a time when it had its birth.

Thus the investigations of modern science, at whatever point of the horizon commenced, converge and unite in the grand and fundamental truth, that "In

THE BEGINNING GOD CREATED THE HEAVEN AND THE EARTH."

When—how far back in the past—the beginning was is not stated, neither does the record afford any clue by which this can be ascertained. For, as already stated, this verse stands as an independent sentence, and relates a creative act distinct from, and long prior to, the work of the six days. The sacred historian, in passing from the event announced in the *first* verse to the state of things described in the *second*, passes over a period of indefinite, and, perhaps, incalculable length. Of the condition of our planet during that period, what changes or revolutions it underwent, nothing is said; but the second verse describes to us its condition immediately before the commencement of the Adamic creation, the history of which begins with the *third* verse. And it will be proper to state here, that this is no new mode of interpretation, or a suggestion of modern geology with a view to harmonize its marvellous discoveries with holy writ. The sacred text was thus understood by the early fathers of the church—by Justin Martyr, Basil, Cæsarius, Origen and others. Of the same view in later days were Patrick, Jennings and Calvin, all of whom wrote before geology was known as a science. They arrived at this view of the inspired narrative solely on Biblical grounds; and now the revelations of geology go to prove that the interpretation they gave is correct.

There is, therefore, nothing to alarm the friend of the

Bible in the geological announcement that the earth may have existed through unmeasured periods before the creation of man. Geology militates not against the Scripture, but against the mistaken, though common, interpretation put upon it. The Scripture nowhere undertakes to inform us *when* this globe was brought into existence; it simply states the grand and important fact, that "in the beginning," whenever that was, "God created the heaven and the earth." Between that beginning and the creation of man, millions of years, or even millions of ages may have elapsed, during which all the physical changes and operations described by geology were going on. But these, like the rings of Saturn, or the satellites of Jupiter, the sacred historian, without saying a word, or dropping a hint, passes by, as not being embraced in the plan or connected with the object of the inspired word.

As the Scripture account of creation does not inform us at what time, so neither does it in what *form* the earth was at first created. The origin of our globe is involved in great obscurity, which the powers of the most gifted have not been able to penetrate. Some, and among them are men equally distinguished for their piety and science, regard it as by no means an irrational thought to suppose that in the beginning the *matter* now composing our globe existed in a most attenuated state, and floated in space as a vast, extended *cloud*, and this gradually, under the influence of gravitation, of cohesive force, and of chemical aggregation,

moulded into the form of a sphere. But whether this supposition is to be accepted or not, certain it is, that we have many and strong evidences to believe that the earth, at a later period of its history, existed in a *melted* state, and has been slowly cooling ever since. Revolving through space, where the temperature is not less than 230° below Zero, (Fahr.) the earth, according to the laws of radiation, must have been all along giving out and parting with some of its heat; consequently the amount of its heat formerly must have been greater than it is at present; and if we run backward through the ages, we shall ultimately reach a period when its heat must have been sufficient to melt all known substances. And that such a state of things actually existed seems to be plainly indicated by the igneous character of the primitive rocks, by the tropical climate that formerly prevailed in high latitudes, and by the present internal heat of the globe. The spheroidal figure of the earth, also, being exactly such as would be taken by a fluid mass revolving with the velocity of the earth, confirms this conclusion.

When the earth was in its molten condition, all the water now contained in its oceans, lakes and rivers, must have existed in a vastly extended atmosphere of steam around it, owing to its intense heat. The cooling process, therefore, went on slowly, as this thick, vaporous canopy prevented rapid radiation. At length, however, a period arrived when a crust was formed over the melted sphere. This, like ice on agitated

waters, was, doubtless, heaved and ruptured at a thousand points, and that, perhaps, a thousand times repeated. But gradually the undulating surface acquired greater thickness and solidity, and became measurably stable; and in process of time its temperature was so far reduced as to admit of the existence of water in a fluid form. Long, however, the dark, "unseen deep must have literally boiled as a pot, wildly tempested from below; while from time to time more deeply seated convulsions upheaved suddenly to the surface, vast tracts of semi-molten rock, soon again to disappear, and from which waves of bulk enormous rolled outward to meet in wild conflict with the giant waves of other convulsions, or return to hiss and sputter against the intensely-heated and fast-foundering mass, whose violent upheaval had first elevated them and sent them abroad."* Thus cooling and consolidating, unmeasured periods passed away; our planet, however, was still but an awful and tenantless waste; darkness and silence reigned universal; "the only sound which occasionally broke the intense stillness being the voice of subterranean thunder; the only motion (not felt, for there was none to feel it) an earthquake; the only phenomenon a molten sea, shot up from the fiery gulf below, to lay the foundation of coming islands, or to form the mighty framework of some future continent." †

At this primeval period of high temperature, seeth-

* Test. of R., p. 197. † Pre-Adamite Earth, p. 71.

ing oceans and steamy atmosphere, there must have fallen, frequently, torrents of rain, of which aught that we now behold can suggest but a faint idea, and which, doubtless, formed rivers and cataracts far surpassing our Amazon and Niagara. The effect of these rains and flowing tides, and high temperature, was to disintegrate and grind and wear the granite surface, and to wash down the debris from higher to lower localities, or to carry them into the beds of existing seas and lakes, to be there deposited and hardened in successive layers; and thus were formed the first *stratified rocks*. Meanwhile, the force of internal fires ever and anon changed the relative level of the surface; the bottom of the ocean was upheaved into high table lands, or mountain ridges, as the former plains and hills sank to be covered by the displaced ocean; and in this manner new continents were produced, new rivers formed, and new deposits made. Thus the internal fires fused and fractured and lifted the granitic rocks, and thus the never-wearied water washed and wore those rocks to dust and soil.

At length, the temperature being sufficiently reduced, and an adequate amount of soil formed from the washed and pulverized rocks, at the bidding of the Great First Cause, such vegetable and animal organizations as could, in that condition of the globe, maintain an existence, began to appear—first in the sea, and then on the land. As these respectively ran their appointed periods and perished, and the earth con-

tinued to improve in soil and climate, at the same Omnipotent bidding, other and higher orders, both of vegetable and animal, were introduced from period to period. In like manner, these again died out, to be succeeded by others still.

In this way the face of the earth was renewed and destroyed, peopled and repeopled, times without number. For ages, and cycles of ages, it passed through alternate periods of upheaval and disruption, and of formation and repose—during the one, the loose materials worn and ground by the elements from hill and dale, together with vegetable and animal remains, were continually carried and deposited at the bottoms of seas and lakes, where, layer after layer, they became hardened into other rocks, amounting to hundreds, and sometimes to thousands, of feet in thickness—during the other, these were again in vast extents heaved, or ruptured, or tilted into various positions. Thus all the present continents and islands of the globe have been, for vast periods, and many of them several times, at the bottom of the ocean, while the regions now forming the floor of the deep, formed as many times the most elevated portions of the earth's surface.

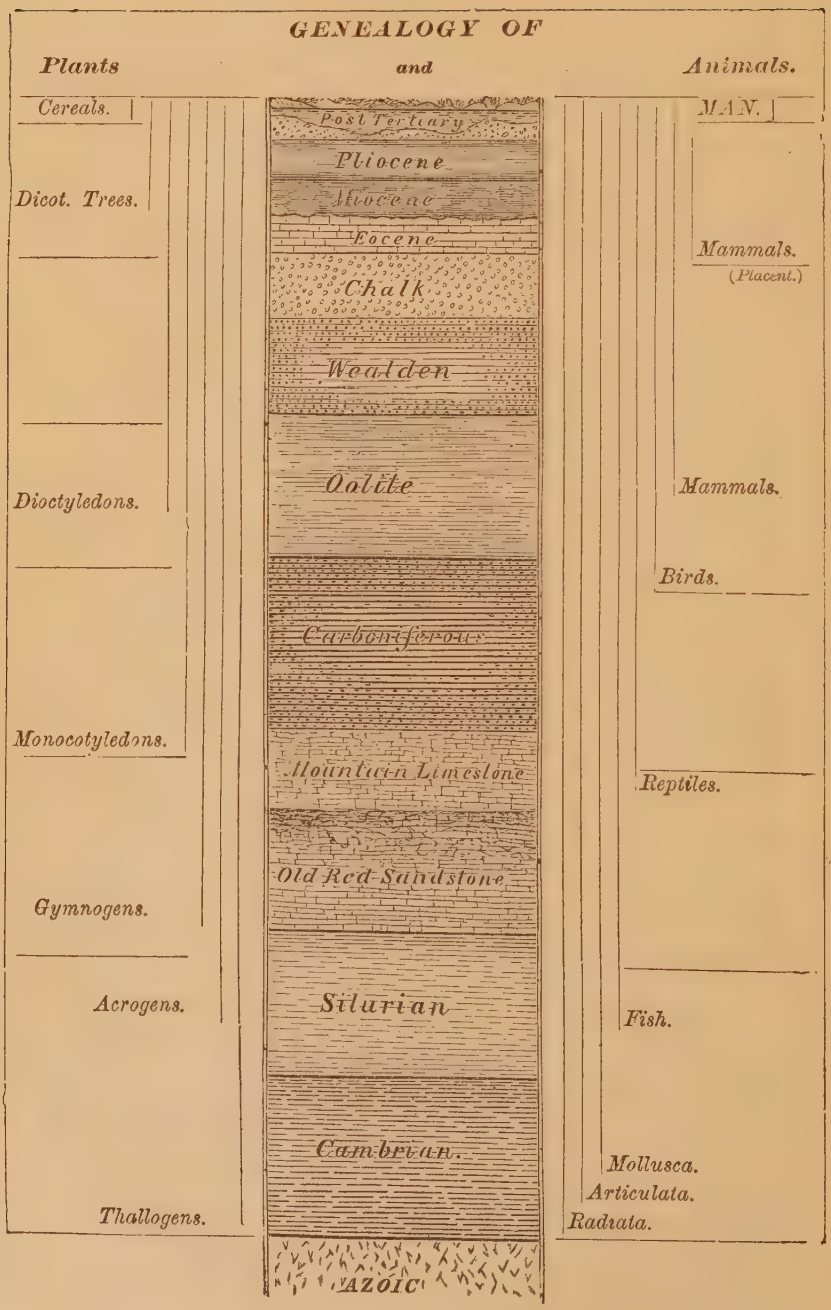
While these mighty periods and revolutions were going on, a vast series of different tribes of animals and plants successively occupied the land and the sea, and of which the variety, multiplicity, and strangeness exceed by far everything which could have previously been imagined. But neither the plan nor the object

of the writer will permit him to notice these in detail, as brought to light by the indefatigable researches of geologists. We may, however, for the sake of illustration, glance briefly at their most prominent characteristics during different epochs of the earth's pre-historic existence.

In the dim obscurity of the earliest CAMBRIAN rocks, no vegetation clothed the scoriated surface of the ground, and no life moved in the deep, dark waters of the sea. But towards the close of this system, whose age is measured by the slow deposit of 5,000 feet formation, we find that the commandment has gone forth, and the sea is swarming with life; myriads of *corals* are already at work building their interminable reefs and barriers; countless multitudes of unsightly *trilobites* are swimming with their backs downward, and looking eagerly for their prey; brilliantly-colored *crinoids* and *stone-flowers* gem the ocean floor; while over them and among them roam powerful races of the *nautilus* and *cuttle-fish*, terribly armed, and inspiring dread in the most formidable inhabitants of the deep.

Descending now over the immeasurable period of the SILURIAN system, of a mile and a half thickness, during which hundreds of animal species ran through their appointed cycle of generations and became extinct, we reach the OLD RED SANDSTONE, whose formation records the *Fish Dynasty;* sharks, rays, etc., being the most marked feature of this period.

Advancing downward still with the flow of time


GENEALOGY OF
Plants
and
Animals.
Cereals.
Dicot. Trees.
Dioctyledons.
Monocotyledons.
Gymnogens.
Acrogens.
Thallogens.
Post Tertiary
Pliocene
Miocene
Eocene
Chalk
Wealden
Oolite
Carboniferous
Mountain Limestone
Old Red Sandstone
Silurian
Cambrian
AZOIC
MAN.
Mammals.
(Placent.)
Mammals.
Birds.
Reptiles.
Fish.
Mollusca.
Articulata.
Radiata.

IDEAL SCENE IN THE CARBONIFEROUS PERIOD.

through unnumbered ages, we arrive at the epoch of the Coal Measures, in which we find, for the first time, large and important indications of land vegetation. The dry portions of the earth's surface, during this period, abounded in rank and gorgeous vegetable productions, among which stood conspicuously the graceful *araucaria*, the tall and spreading *lepidodendron*, with its feathery fronds, the huge *club-mosses*, the elegant *sigillaria*, the strange *tree-ferns*, with gigantic *pines* and *firs*, "all begirt with creepers and parasitic plants, climbing to the topmost branches of the tallest among them, and enlivening, by the bright and vivid colors of their flowers, the dark and gloomy character of the great masses of vegetation."* These primeval forests, however, so far as known, do not appear to have ever echoed to the voice of birds; nor does there remain an indication that a quadruped or reptile ever roamed through their tangled solitudes. The fossils of a few insects, indeed, remain to testify that animal life was not altogether absent. The sea, however, was now abundantly peopled.

Repeating again our flight, and passing by the extended periods of the Magnesian Limestone, we next alight on the New Red Sandstone. Other races, we now see, have taken possession of earth, air, and water. *Birds* now track the sands and wade the shallows, of a bulk three times that of a modern ostrich, and *dragon-flies* and *beetles* hum through the air.

* Ansted.

Coming to what has been named the LIAS formation, we reach the *Reptile Dynasty*. These formidable creatures now become the lords and tyrants of creation—the combatants and consumers of each other. *Crocodiles* and *lizards* and *gavials* everywhere abound. Huge, *bat-like reptiles*, vaster than the fabled dragons of old, are flitting through the air; ponderous *batrachians*, or frogs, large as a rhinoceros, are dragging their unwieldy bulk along the sand; fierce and enormous *sharks* roam and reign through the ocean; the rapacious *megalausaurus*, taller and larger than the bulkiest elephant, here and there is crushing his resistless way through the tangled brakes; and from many a tepid bay is seen the frightful *ichthyosaurus*, with eyes well-nigh half a yard in diameter, glaring upon its unsuspecting victim, which, whatever its size or strength, it is sure to prostrate with a single stroke of its enormous tail, and engulf at a single mouthful in its horrid jaws.

Quitting our stand-point once more, and sailing over the thousands of years, and of ages, occupied in depositing the vast OOLITIC and CHALK formations, we come down to the TERTIARY epoch, and take one more glance at our globe in its pre-Adamite condition. Between this epoch and the last, terrible and oft-repeated disturbances have taken place in the relations of sea and land; hence every living species that formerly occupied the earth has disappeared. Fishes and reptiles still exist, but they are far inferior to those of former periods.

ICHTHYOSAURUS AND PLESIOSAURUS.

But now appears a mighty race of quadrupeds. Terrible and fierce creatures they were. *Hyenas, bears, tigers,* of huge proportions, now roamed the earth. The *elephant,* the *mammoth,* and the *mastodon* also traversed the plains and forests, even in far northern latitudes. Besides these, there were others of much vaster size than any now extant. The *Deinotherium* was an elephant-like creature, but twelve feet high and twenty feet in length, and robust in proportion, with two enormous tusks curving downward from the under jaw. The *Megatherium,* as its name implies, was a brute of stupendous proportions; the monstrous pillars which supported the body were like forest trees, and were three times the thickness of the largest elephant's; the width across the loins was about six feet. The print of the forefoot was about a yard long, and twelve inches wide; that of the hind foot about half as large again. The feet were furnished with claws ten inches in length, and about twelve inches in circumference at the root. Its tail was five or six feet in circumference. Its mode of living was to tear up large trees by the roots, and strip them of leaves and radicles. In motion it was very slow; but it had little need of speed, when, for defence against its enemies, it had a coat of mail an inch thick, and with one tread of its foot, or one lash of its tail, it could kill the largest puma or tiger.

In the POST-TERTIARY period, even that region of the globe which now embraces the British Islands, was inhabited by huge and most formidable races

of animals, of which Prof. Owen gives the following picture:

"Gigantic elephants, of nearly twice the bulk of the largest individuals that now exist in Ceylon and Africa, roamed here in herds, if we may judge from the abundance of their remains. Two-horned Rhinoceroses forced their way through the ancient forests, or wallowed in the swamps. The lakes and rivers were tenanted by Hippopotamuses, as bulky and with as formidable tusks as those of Africa. Three kinds of wild oxen, two of which were of colossal strength, and one of these maned and villous, like the Bonassus, found subsistence in the plains." During this period vast and wonderful changes were wrought in the surface of the earth; the great dynamical agencies of the globe were in intense and incessant activity over the broad expansions of sea and land, as if hastening to completion the great terrestrial structure.

Geology has revealed to us not only the fact that our planet was occupied by a long succession of animal races, such as we have now glanced at, but also that these were introduced in an *ascending order*. "There is a manifest progress in the succession of beings on the surface of the earth," says Agassiz, "and this progress consists in an increasing similarity to the living fauna; and among the vertebrate especially, in their increasing resemblance to man. Man was the end toward which all the animal creation tended, from the first appearance of the first Silurian fishes." Man, the last in time, but

REIGN OF QUADRUPEDS.

the first in the contemplation of the Creator, was pre-ordained to be the *final* and *most perfect* product of this vast and magnificent plan of terrestrial creation.

Geology further establishes the fact, that throughout these pre-Adamite periods, there was also a progressive preparation of the globe itself—of its atmosphere and climate, soil and productions. But when it had reached even the close of its geological history, it was not yet fully prepared for the reception of man; for still it lacked many things essential to his comfort, and even to his existence. Down to the last of the Post-tertiary deposits there has been discovered no fossil, or certain trace of a fossil, of any of those plants which yield wine, or oil, or bread, or perfume—none of those which so charm us with the beauty of their colors and the richness of their fragrance—none of the cereals, wheat, barley, rye, millet, rice, maize, which constitute our staff of life. These were to be among the productions of the last and human epoch of our planet.

We have now given an outline of the history of our globe during its pre-Adamic existence, as human investigation has been able to decipher it. Striking and startling as the foregoing statements may appear, and differing from anything which the imagination of man in former ages conceived of the history of our world, still they are sober truths, and are established in our day, by evidences so complete and undeniable, as to leave no doubt whatever of their reality, on the minds of those, who, with the requisite qualifications, have

studied the subject. However, neither from the formation of the rocks, nor from the fossil remains which they contain, can we form any definite or certain calculation as to the *actual age* of the planet upon which we live. But all facts and indications concur in assigning very great and gigantic periods of time, as having been occupied by the events which formed its strata, and brought them into their present condition. "There is nothing which at all goes beyond the magnitude which observation and reasoning suggest for geological periods, in supposing that the Tertiary (or latest) strata occupied, in their deposition and elevation, a period as much greater than the period of human history, as the solar system is larger than the earth :— that the Secondary strata were as much longer than these, in their formation, as the nearest fixed star is more distant than the sun :—that the still earlier masses, the Primary, did, in their production, extend through a period of time as vast, compared with the Secondary period, as the most distant nebula is remoter than the nearest stars. If the earth, as the habitation of man, is a speck in the midst of an infinity of space, the earth, as the habitation of man, is also a speck at the end of an infinity of time. If we are as nothing in the surrounding universe, we are as nothing in the elapsed organic antiquity, during which the earth has existed and been the abode of life."*

* Plurality of Worlds, p. 122.

REFLECTIONS.

IN THE BEGINNING—amazing era! The words carry back the mind, awed and bewildered, to that immeasurably distant and dateless period, when all that we now behold, and all that now exist, were not—when no sun illumined the voids of space, no moon relieved the darkness of the night, nor a star twinkled in the heavens—when time had not concluded or commenced its first revolution—when no sound, no motion had ever broken the everlasting silence—when neither mind nor matter was to be found in all the dark profound—when GOD was the alone existence! Then, even then, He was, and was all that He now is, in wisdom, and power, and love, and happiness! Alone, He inhabited the solitudes of eternity! What awe, what reverence should such thoughts awaken in every breast! He who is not inspired with sentiments of devotion by such reflections as these, must be dead to what chiefly ennobles all created intelligences.

The scenes, awful and sublime, now surveyed, point us to the Supreme Being, as sitting upon "the throne, high and lifted up," moving all things; but remaining himself unmoved and immovable, directing every revolution of the vast creation; but himself affected by no progress of events, by no lapse of time; not younger nor more vigorous ten thousand ages past, nor older or more faint ten thousand ages to come! Immutable in essence and attributes, He remains the same "yesterday, to-

day, and forever." When mountains rose or continents sank, or races were swept away and perished, He was as impassive and unmoved as when but a sparrow expires, or a feather falls to the ground. He was still of one mind, and still His mighty plans, undisturbed, moved on. Independent of all created existences, He sits at the head of the universe, unchanged and incapable of change.

In the geological survey now taken, we discover both a proof and an illustration of the declaration, "known unto God are all His works from the beginning." In the Divine mind existed the universe, in all its magnitude and minutiæ, eternal ages before the utterance of the first *fiat* of creation. In His book, all its parts, and periods, and motions were written, when as yet there was none of them. And His plan was perfect; it neither needed nor received the shadow of a change in the course of its execution. No mistake was made, no delay occurred. As a train arriving successively at the stations along a line of road, at the precise minute marked for each place in the time table, so the earth, in its formation process, reached its several stages at the epoch, and period of the epoch, marked in the Divine plan; so that the successive tribes of animals and plants, as they were brought forth, found the earth, both as to soil and climate, ready to receive and support them. The Contriver and Builder of the world foresaw all the revolutions which the course of ages would produce, and the mighty work ever advanced infallibly

and without interruption. "Look on it when He would, He found it arrived at that stage where a thousand ages before He foresaw it would be. And look forward to what distant age He might, He beheld it in anticipation, already there arrived." No plan, no purpose of God, can fail of its accomplishment.

In these scenes of ancient creation, we behold a striking display of the all-comprehending wisdom and universal agency of God. Here we witness "all things working together," through the course of ages, to further and accomplish His purpose. From the beginning, the earth was designed to be a habitation for man; and to fit and furnish it for him, all the revolutions our planet experienced, all the transformations through which it passed, all the forces and influences to which it was subjected, unitedly and unfailingly conspired, through all the long epochs of its preparation. Every volcano that burned or belched in the morning of time—every hurricane that swept over the primeval seas—every earthquake that, in after periods, heaved its solid crust—every electric shock that rent the clouds, or vibrated through the rocky strata—were made under the guiding hand of the Divine Builder to work, and to work together, toward perfecting this terrestrial abode. Fires fused, and forests flourished, to enrich with precious stores its everlasting hills. The gigantic races that browsed over ancient continents, and the tiny corals that toiled at the bottom of ancient oceans, were alike called forth to be laborers on the noble structure.

"Each trilobite, each saurian, and every one of the mammalia, which exist now in the fossil state, were small laboratories in which the great work of eternal change was carried forward; and under the compulsion of the strong laws of creation, they were made ministers to the great end of forming a world, which might be fitting for the presence of a creature endued with a spark taken from the celestial flame of intellectual life."*

* Poetry of Science, p. 264.

The Chaotic Period.

The earth is submerged and tenantless, and enveloped in thick darkness.

CHAOS COMING ON.

THE CHAOTIC PERIOD.

GENESIS 1 : 2.—And the earth was without form, and void; and darkness was upon the face of the deep: and the Spirit of God moved upon the face of the waters.

THE inspired historian, having introduced his subject with the sublime announcement, that "In the beginning God created the heaven and the earth," in this verse describes the state in which our globe existed immediately prior to the commencement of the Adamic creation. Between these verses, therefore, as has been set forth in the preceding pages, there is a chasm of unnumbered ages in the sacred narrative. Respecting the events and doings of this immense interval, the Scripture is entirely silent, as they did not relate to the moral history of our race, or come within the design of Revelation. This missing chapter in the history of our planet we have been left to supply for ourselves, from the physical monuments of the Divine power and wisdom, found in the rocky crust of the earth.

The condition of the globe, then, immediately before the creation of man, was that of a watery waste, desolate and wrapped in darkness. Some geologists, however, of late, have questioned this fact; these hold that

the earth could not have been in such a state at that period—first, because they have not been able to discover in its later or surface deposits any certain evidence of such a chaos; and, secondly, because they can detect no such a *break* in the chain of fossil vegetable and animal species as will warrant or admit this supposition. These objections are urged, and have force *only* on the mistaken hypothesis that this verse asserts a state of things in which "the sea, the earth, and the heaven, were a rude and indigested mass, the disagreeing seeds of jarring elements confusedly jumbled together in the same heap,"* in which no trace of animal life, or of vegetable organism, was anywhere to be found. But the sacred text, when fairly interpreted, conveys no such idea as this. Let us examine it.

The original words *tohu vavohu*, rendered in the authorized English version, "without form and void," in the Septuagint or Greek version are translated "invisible and incomposed;" and in the Chaldee, "desert and empty." Bush, in his Notes, holds that their true import is "dreariness and desolation." It will be noticed that all these translations happily coincide, and are essentially identical. All that the passage, then, imports is, that our globe at this period existed as *a watery and featureless desolation, enveloped in darkness*—a condition similar to what it had repeatedly passed through before, in the course of its eventful history.

* Ovid's Meta.

It will be observed that the sacred historian says nothing about the *duration* of this submerged and desolate condition; neither do his words offer the slightest intimation from which it can be inferred. That it was an *immense period*, is wholly a gratuitous assumption—it might or might not have been such. While it may suit the views and help the arguments of those who deny a chaotic state of the globe at this time, to speak of it as being thousands of ages, the language here employed permits us with equal right and consistency to suppose that it might not have exceeded a thousand days. "The periods of disturbance on the globe," says Hitchcock, "appear to have been short, compared with the periods of repose that intervened." The last cataclysm (the Deluge) through which our world passed, we know, was brought about, and wholly passed away, within the brief period of a single year.

Nor, again, does this verse or any of those that follow, require us to believe that *all life in the waters*, at this time, must have been *extinct*. Multitudes of the inhabitants of the sea passed in safety, and long survived even the earlier and more tremendous revolutions of the earth; and at no period, after the first dawn of animated existence, were the oceans left wholly tenantless. For anything that is here said or implied, various tribes of fishes might have continued to live and propagate their kind throughout this chaotic period, though utter darkness everywhere prevailed;

for, at the present time, as under the ice of the Polar Seas, and elsewhere, fishes live in darkness. In the great Cave of Kentucky we find that fishes have lived and thrived and multiplied for ages, where not a ray of light ever reaches their gloomy abodes. To those species which survived the *tohu vavohu* period, many other and nobler species were added, indeed, by the *fiat*, which, with vivifying omnipotence, passed through all the deep places of the sea on the morning of the fifth day.

Nor, once more, is it said or implied in this verse, that even the whole of the *solid ground* was under water; the language used does not necessarily bind us to this conclusion. Portions of land, such as lofty mountain ranges, and even parts of elevated plateaus, like those of central Asia, might have been, doubtless were, above the general level of the waters; so that it might properly and truly be said, "the earth was standing *out of the water*, and in the water."* Nor is there anything in the Record before us, or in the condition of things described, to forbid the supposition that vegetation, together with certain animals, (such as those claimed by geologists to have existed long ages before man,) might have survived the catastrophe on these *unsubmerged portions* of the earth's surface. The more dank and dense vapors arising from the face of the agitated deep, and shutting out the light of the sun, would naturally float in dark and heavy folds in the

* 2 Peter 3 : 5.

lowest regions of the atmosphere, but growing thinner and lighter with increasing altitude; so that while darkness, unmitigated darkness, was upon the face of the waters below, the elevated mountain tops might have been relieved by a degree of light and warmth from the sun, which rendered them, in many latitudes, a far more favorable abode to life than are the present arctic regions with their intense cold and months of winter darkness, which yet are the chosen homes of many species of living creatures. Among all its revolutions, geology records no catastrophe that swept away *all* living creatures at a stroke, leaving the entire earth tenantless; while multitudes were often destroyed, more or less always survived. And why may we not suppose the same of this last catastrophe?

Nor, finally, does the Mosaic Record state, neither is there anything in the discoveries of geology to decide. *the precise way* in which the globe was reduced to this chaotic condition—whether by the subsidence of the dry land, or mainly by a general elevation of the beds of the ancient oceans. It might have been by the one or the other; "many of the apparent elevations of the land," says Dana, "may have been due to the deepening of the oceanic basin; and some of the apparent subsidences of the land may have been caused by an elevation of the oceanic basin." If, therefore, this chaos was brought about mainly by the elevation of the ocean floor, thus sending abroad its waters over the land; and if the gathering together of those waters, in order

to make the land again appear on the third day, was effected mainly by the sinking of the ocean floor—then the surfaces of the old continents have remained undisturbed, and their relative levels and respective plains, elevations, and declivities continue as they were of old; so that the sublime pinnacles of the Alps and the Ararat stand now as they stood in the midst of the former creation, and the Niagara and the Colorado flow to-day along the same rocky channels that they began to scoop out numerous ages before the earth had been reduced into the chaotic state here described. The foregoing suppositions are in perfect harmony with the teachings of geology;* and the generality of the Mosaic statements, when fairly considered, will be found entirely compatible with them all.

Let us now glance at *the actual physical changes* that were required to reduce the globe into the submerged state here described. Humboldt has estimated the mean elevation of Europe at 671 feet; of Asia, 1151 feet; of North America, 748 feet; of South America, 1132 feet; and has set the mean elevation of all the continental lands at 1008 feet. If the high mountain ranges were left out of the calculation, this *mean*, as is obvious, would be greatly reduced. The whole north of Europe and Asia is merely a boundless plain; and from the shores of Holland, through Germany, Russia, the Steppes of the Caspian and Siberia, the traveller may cross the ancient world from the Atlantic to the Pacific ocean, a

* See Hitchcock's Elem. of Geol., p. 157.

distance of more than 6000 miles, without encountering an eminence of more than a few hundred feet high. The extended plains of the Ganges and of the Euphrates have but a small elevation above the ocean level. In Africa also, the plains of Sahara extend 2500 miles in length, by 1000 miles in breadth. The mean elevation of Australia does not exceed 500 feet. In the New World, plains form two-thirds of the entire surface; almost the whole East of it runs into immense plains, covering it, one might say, from pole to pole. From the Frozen Ocean to the Gulf of Mexico, over an extent of nearly 2400 miles, we cross only insignificant heights. From the llanos of the Orinoco to the banks of the La Plata, we traverse more than 3000 miles of low plains, slightly interrupted by the somewhat more elevated regions of western Brazil; they are prolonged even to the pampas of Patagonia, 600 miles further south.* It has been estimated that if all the land above the present water-level were transferred into the ocean basins, it would occupy only *one-fortieth part* of their capacity. From the foregoing facts, it is obvious that an elevation of a few hundred feet only of the present bed of the ocean, attended, as it would be, by a corresponding depression of the land, would reduce all the existing continents of the globe into a few irregular and scattered islands—would, in fact, reduce the earth into precisely the condition described in the verse now under consideration. But a less elevation of the bottom

* See Guyot's Earth and Man.

of the seas than even this, by considerable, would have sufficed to submerge the earth at the commencement of the human era: for the oceans, according to the testimony of geology, have been constantly growing deeper, and the continents higher, ever since.

Having premised the foregoing facts, we are now prepared to consider the *objections* urged against a chaotic condition of the globe, at the period in question.

Objection 1. It is urged that the earth's surface affords no indication of a pre-Adamite chaos, such as we speak of. To this we may reply, that conclusions reached through mere negative evidences are generally of a doubtful character. The heavens to-night may exhibit no traces of the descent of a meteoric shower, but that does not prove that such a thing did not happen on a former night. The same may be true of the case before us. That watery chaos may have left its marks, doubtless has, at a thousand points; but men looking for something *greater*, or something *different*, may not yet have learned to distinguish them. The inspired account before us does not require us to suppose that this chaos, like some of the tremendous cataclysms of the earlier epochs, was brought about by sudden or violent paroxysms, or that it was of numerous ages' continuance, such as would of necessity leave lasting and ineffaceable marks or relics behind it; the internal forces of the earth had all along been quieting down, and the condition of the globe here described might have been the result of a slow subsidence of the land,

TEMPLE OF JUPITER AND SERAPIS.

and an equally slow elevation, at the same time, of the beds of the ancient oceans; so that its surface generally became covered with water, without a stratum being overturned, or tilted out of its place. Geology teaches us, that the process of both elevation and depression often goes on gradually and imperceptibly. "There have been instances," says Prof. Hitchcock, "of quiet, gradual elevation without catastrophe; and it may not be possible, in all cases, to find evidence of any great geological disturbance at the close of all the life periods." Such movements in the earth's crust are constantly taking place at the present period.

The temple of Jupiter Serapis, at Pozzuoli, was originally built at the level of the sea. Subsequently, the ground gradually subsided to the depth of 21 feet, and its interior became a lake. At length the land gradually rose again, until the pavement once more stood on a level with the sea. Three of its columns are now standing, and bear clear evidence of their submergence; the lower 12 feet of these columns, being immersed in mud, remain smooth, but for 9 feet above they are penetrated by the little boring shells of the Mediterranean, and remains of these shells were found in their holes.

On several parts of the coasts of Britain and Ireland, the voyager can look down through the clear sea, in depths to which the tide never falls, on the remains of submerged forests. The whole mass of Scandinavia, an extent of 1000 miles from north to south, is being

elevated at the rate of from two to four feet per century. On the other hand, the west coast of Greenland, for a distance of 600 miles, has been sinking for ages; old buildings and islands have been submerged; and the Moravian settlers have had to put down new poles for their boats, and the old ones stand as silent witnesses of the change.* It has also been shown, beyond all question, that the eastern part of South America has been raised, in the most quiet manner, without disturbing the horizontality of the strata, from 100 feet to 1400 feet, over an extent of 1200 miles, since the Drift period. . With such facts, then, before us, where is the difficulty in admitting and believing that the earth, at the period in question, was reduced to a watery chaos, and then restored, *though no ruptured strata, or buried fossils, or ruined mountains, remain to prove it?* We find a distinguished geologist, while denying a pre-Adamite chaos, in laboring to establish his favorite theory of the Noachian deluge, with great facility depressing the surface of the earth by *millions of square miles*, and bringing in the waters of three distant seas to overwhelm it to the depth of 16,000 feet; and then with equal facility drawing off the mighty ocean, and elevating the whole extent to its former level—and all this, as he represents, without leaving behind any recognizable evidences of the occurrence.† Countenanced by so high an authority, then, as Hugh Miller, why may we not suppose the same in regard to this primeval

* See Lyell's Prin. of Geol. † Test. of Rocks, page 358.

chaos? If the absence of evidence does not disprove the one, why should it the other?

Objection 2. It is argued against a chaotic condition of the globe, at the period immediately preceding man, that certain vegetable productions, such as the *Scotch-fir*, the common *birch*, the Norwegian *spruce*, etc., flourished in times long anterior to the human race, and that these flourish still, which could not have been the case had such a chaos intervened. Admitting this to be a fact, it does not involve our position in the slightest difficulty. The existence of such trees, and of many other vegetable productions, might have been safely conveyed across the chaotic period *in their seeds*, buried deep in soil or mud; many of these seeds, after the waters had been withdrawn, would, under suitable conditions, in any region of the globe, sprout and grow as successfully, as they would have done on the day they fell upon the ground. The longevity of seeds may be reckoned among the greatest marvels of creation. Grains of wheat, after having lain buried with mummies for twenty-five centuries, when moistened in the soil and warmed by the sun, have germinated and reproduced as vigorously as if they had been the product of last harvest. Seeds that grew long ages before Adam woke to consciousness, may at this day be found in the ground, possessing their original vitality undiminished and uninjured. A few years since, earth was brought up in England from a depth of 360 feet, and carefully covered with glass to prevent the possibility of any

blown or floating seeds being deposited upon it; yet, in a short time, plants vegetated from it. Indeed alluvial and diluvial soils appear to be full of seeds to unknown depths, the produce of ages long gone by, and which need but to be brought to the surface, to sprout and thrive, as if they had but yesterday dropped from the parent plant. In this way, therefore, many of the plants and trees of the old earth might have survived the chaos; and some of them might have sprung up spontaneously even in Eden, among the more perfect, more valuable and beautiful species, that were then for the first time called into existence. And to this distinction in the origin of the present vegetation of the earth, perhaps, refer the words—"Every plant of the field before it was in the earth, and every herb of the field before it grew."*

Objection 3. It is contended against the doctrine of a chaotic state of the globe at the commencement of the human period, that between several species of animals of the present time, and those of the former creation, there occurs no *break;* that one continuous chain of organic existences connects the modern world with the pre-Adamite world. But may we not ask, will this chain hold good throughout? Has it been proved that all the links have actual connection? or, are there not points at which they may lie simply in close proximity? Is there no room for honest difference of opinion here? We think there is. Hugh Miller tells us, "there

* Gen. 2 : 5.

may be portions of the prophetic pre-Adamite *past*, of as doubtful interpretation at the present time, from the imperfect development of physical science, as is any portion of the prophetic *future*, from the imperfect development of historic events." It is a possible thing, then, that the links may be very similar, and may be found very near together, and yet not exactly form a chain. The destruction of the plants and animals before the chaos did not make it necessary or certain that those which were to occupy the earth after it, should be *all different* from them. The species existing before the deluge were preserved and carried forward to repeople the earth after it; so certain species of the old earth, as already indicated,* might have been preserved on the mountain tops, to prolong their existence through the era of man; or, the Creator, in peopling the new earth, might have reproduced such of the species of the bygone world as were most suitable to be contemporaneous with man. In either of these ways, perhaps in both, the fossil remains of animals living before the chaos, and the fossil remains of the same animals living after it, may be found in many localities lying together, and that so closely and so mingled, that at this distance of time, they *may appear* like "a continuous chain," while in reality between their life-times may have intervened the billows and the darkness of the chaos here described.

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* See p. 53.

It remains yet to be proved, however, that any of the *living* and *fossil* species are *identical*. Several that were once considered the same, have, of late, upon closer and more careful examination, been pronounced different. "The number of species," says one of the greatest of living naturalists, "still considered identical in several successive periods, is growing smaller and smaller, in proportion as they are more closely compared." Future and further investigation, therefore, may do away with the few that remain; indeed, even now, "eminent naturalists, among whom Agassiz stands at the head, are of the opinion, that the fossil and living species are not in any case, perhaps, identical; but only closely related."* The horse, the ox, the deer, the camel, etc., of the former creation, were of a larger size than the living species.† So, also, were the beasts of prey.‡ The "continuous chain" of animal existence, therefore, has not yet been demonstrated; consequently, the objection based upon it against the chaotic condition of the globe, at the period in question, is without force. But even were the identity of species fully established, the fact might be accounted for in perfect harmony with the existence of a chaos, on either of the suppositions stated in the preceding paragraph.

Having examined what has been urged by way of objection, let us now proceed to inquire what evidence of a positive character may be found respecting a chaos on the eve of man's creation.

* Hitchcock's Elem. of Geol., p. 328. † Ib., 349. ‡ Dana's Geol., p. 573.

1. That the earth underwent some great physical revolution immediately before the commencement of the human age, seems to be strongly indicated by the great change that took place in its *climate* about that time. Formerly, the general temperature was much higher; the character of both animal and vegetable fossils goes to show that a tropical climate prevailed even in high latitudes. "The Terrace epoch," says Dana, "belongs, at least in part, to *man*, and the last of this epoch —in which the continents were raised nearly to their present level—again cooled down the earth, and ended in introducing approximately the existing climates of the globe; and the extermination of the cave beast of Europe, and other Post-Tertiary species, may have been coincident with this great climatal change."*

2. That the earth existed in a chaotic condition immediately previous to the epoch of man, is further indicated by *the general extinction* of the animal species belonging to the old world, which took place at that period. "Very few fishes, reptiles, or birds of the present era," says the author just quoted, "are yet known, from any discovery of fossils, to have existed in the Post-Tertiary."† And Hitchcock bears similar testimony: "The fossil birds and mammals of the alluvial period belong almost exclusively to extinct species, and often to extinct genera."‡ In the *Podrome de Palæontologie* it is stated, that "between the termination of the Tertiary period and the commencement of the hu-

* Manl. of Geol., pp. 554 and 567. † Ib., 576. ‡ El. of Geol., p. 342.

man period, there is a *complete break*," in animal existence. Now, how are we to account for this general extinction of animated creatures at this period? Let a geologist help us to an answer: "The extermination of species," writes Dana, "was, in general, due to catastrophes." Now, as the extermination at this period was *general*, the catastrophe occasioning it must have been equally general; and this is precisely the state of things indicated in this second verse.

3. That the waters of our globe were gathered together, and their bounds much contracted, about the beginning of the human period, is attested by many facts of recent discovery. Since the Post-Tertiary epoch, a vast area of the floor of the Pacific, measuring 6,000 miles in length, and from 1,000 to 2,000 miles in breadth, has been depressed thousands of feet; 200 islands have disappeared beneath the waters, and the whole amount of subsidence is estimated by Dana to be no less than 6,000 feet.* The same writer mentions facts which are strong testimony that just about the opening of the age of man there was a great subsidence also, of the bed of the Mediterranean.† The sea-beds around the British Islands, likewise, were depressed about the same period. Similar subsidences in other parts are also mentioned by geological authorities. Now, as the Sacred Record, according to its plain and natural sense, declares that the waters which covered the earth were, at this time, "gathered together," we

* Manl. of Geol., p. 587. † Ib., 734.

may, with reason, believe that in these *contemporaneous subsidences* we have the result of the Almighty impulse that attended the *fiat*, "Let the dry land appear."

4. One of the general laws established by geology is, "That at the close of long epochs, there were nearly universal extinctions, followed by *abundant creations*."* In perfect harmony with this law, there was at the beginning of the human period a magnificent creation, both of plants and animals. Than this there is not a fact in the whole compass of geological investigations better attested. The present species of the horse, rabbit, bison, peccary, beaver, musk-rat, elk, deer, raccoon, opossum, hog, sheep, dog and ox, are said by leading geological authorities to date from the Terrace epoch, toward the close of which man appeared.† "The most important feature of the alluvial formation," writes Hitchcock, "was the introduction of man near the close of the period, and of numerous species both of animals and plants, much better adapted to his wants than the analogous races of earlier times."‡ Again: "This last creation is distinguished from all that preceded it on the globe, as it presents by far the fullest and most perfect fauna and flora."‖ "The creation of man," continues the same author, "along with a vast number of contemporaneous species of a higher grade than the earth had before seen, and forming the culmination of

* Dana's Manl. of Geol., p. 398.
† See Holmes and Leidy.
‡ Elem. of Geol., p. 324.
‖ Ib., 342.

organic existence on the globe, is the most marked feature of geological history, and marks off the alluvial period from all others."*

Let us now review and bring together the foregoing facts, and place them as in one focus, in order to perceive their full force. We have seen that the *second verse* of the Mosaic account of creation teaches and directs us to look for nothing more than a cataclysm, or general deluge, of longer or shorter duration—that geology proves that such a cataclysm might have taken place without leaving behind it, in the earth's surface, any demonstrative evidence of the event, and that the facts urged in disproof of a chaos may be explained in perfect harmony with that event. We have also seen that it is the teaching of geology, that *early* in the Terrace or alluvial period, there was a general extermination of the animal races, and a great and sudden change in the climate, such as a cataclysm would naturally effect—that just about the *close* of that period there occurred numerous subsidences of the ocean-beds, while the continents were raised to about their present elevation—that just about that time was introduced the present magnificent vegetation, vegetation such as never adorned the globe before—that just about that time were created the noblest and most perfect races of animals, which now occupy the face of the earth—and, finally, that just about that time MAN himself was created, and walked forth in the image of his Maker.

* Ib., 355.

Now, centemplating these striking events in and by themselves, and as all taking place just about the same time, and that time coinciding with the commencement of the human period—is not the conviction irresistibly forced upon us, that all this not only stands in perfect harmony with the Inspired Record, but is powerfully corroborative of all its statements. We actually have, in the foregoing facts—facts all admitted and taught by geologists—the substance of all that the literal interpretation of this chapter requires. The evidence on the face of the earth, so far as it has been investigated, and the testimony of the Word of God, are here at one. Here is entire harmony in facts, and complete coincidence both in time and order. Stronger corroborations, considering the source from whence they have been derived, together with the length of time which has since elapsed, could hardly have been looked for. Hence we firmly believe, certain geological authorities to the contrary notwithstanding, that at the beginning of the epoch of man, *the earth was without form and void, and darkness was upon the face of the deep;* and that this chaotic condition of the globe was immediately followed by the creation of the present order of things, just as related in this chapter.

The foregoing view of the Pre-Adamite chaos is, moreover, in perfect harmony with *the course of creation,* as revealed by geology, during the preceding epochs. This submerged condition of the globe was but one of a series of similar catastrophes; and the creation that

followed it was but one of a series of similar, but ever ascending, creations. And as the plant and animal creations of former periods, in every instance,* followed some great geological disturbance, which had destroyed those occupying the earth before; so the Adamic creation followed the chaos which had swept away the animals of the ancient earth. And, as through the course of prior revolutions, the organic existences of adjacent periods and formations were ever united by a less or greater number of connecting links; so, in the ways before indicated, representatives of the fishes, and plants, and beasts of the Old world survived this chaos to connect them with the new and higher order of creatures in the era of man. Thus, as had been the case all along through the prior epochs, the old and the new creation joined and dovetailed into one another, in the sea and on the land, among plants and among animals.

The design of the account given of the condition of the globe, in the *second verse*, seems to be to prepare the reader for the description which follows of the six days' work, which begins at the *third verse*; for it both indicates the *necessity* for such a recreating work, by affirming the chaotic state of the earth; and describes the Spirit of God as already hovering over the chaos *preparatory* to it.

And the earth was without form and void. Bush would translate this sentence, "And the earth *had*

* D'Orbigny.

become without form and void." The learned and judicious Dathe renders it, "Afterwards the earth *became* waste and desolate." Whichever of these translations we adopt, the idea is plainly conveyed, that at the period immediately preceding the Adamic creation, the earth existed as the submerged ruin of an anterior world, a condition of things, as already observed, similar to what had before repeatedly taken place.

And darkness was upon the face of the deep. This darkness was the result of the chaotic state into which the earth had been thrown. The commingling of land and water—the agitation of tides and currents, and of violent and frequent tempests attendant upon the change of climate—the smoke and steam of submerged volcanos—the warm ground of the old continents beneath the waters, together with subterranean fires, and perhaps molten lava spreading in many regions in fields along the bottom of the seas—all of which, together with the evaporation of the sun from so vast and agitated a body of waters, in process of time, engendered such prodigious masses of dense vapors, forming layer upon layer of "closely packed and darkling clouds," which excluded every ray of light, and thus threw a pall of darkest night over the whole surface of the turbid and tumultuous deep below.

How long our world remained in this chaotic state, we have no means of determining. The eventful hour now, however, was at hand, that was to introduce a series of re-creative operations which were to advance

it to its final state of perfection, and to fit and furnish it as a suitable and happy abode for intelligence, devotion and love.

And the Spirit of God moved upon the face of the waters. The word translated "moved" here, in Hebrew lexicons, is rendered "fluttered like a dove," and the verse might have been translated, And the Spirit of God continued fluttering, after the manner of a dove, upon the face of the waters. What effect or operation is here described is not precisely known. When the Spirit, like a dove, descended at the waters of Jordan, it was in attestation of the Father's complacency in his well-beloved Son; so, here, perhaps, the chief idea intended to be conveyed is, that the Almighty surveyed the chaotic earth with complacency, as the theatre upon which he was about to display his glorious power, and wisdom, and goodness, in the new creation.

REFLECTIONS.

In the chaotic condition of our globe at this period, we may see a striking and instructive emblem of the present disordered state of the moral world. At this dismal date, how strange, how mysterious was the aspect of our planet—a vast heaving deep, a boundless desolation, all wrapped in dread and impenetrable gloom! How different from everything that, beforehand, we would have expected from Infinite Wisdom and Infinite Power! Yet not less strange or dismal has been the aspect of the world of mankind. What

disorder and conflicts, what depravity and ignorance have marked our race through every period of its existence! Its history, for the most part, has been a history of sin and its fruits, a history of tyranny, slavery, lust, carnage and devastation, in every region of the globe. A vast preponderance of the whole population of the earth has been lying for hundreds and thousands of years, in a state of barbarism and misery, sunk in such gross ignorance and superstitions as have degraded them far below the rank of rational beings. Man, for the most part, appears to have spent his transient existence in diffusing the miseries which himself has been doomed to suffer, in destroying his fellow-creatures for gain, in deceiving and being deceived, in robbing and being robbed. "The bulk of mankind have been nothing more than a crowd of wretches, equally criminal and unfortunate." And if from these we rise to the remaining fraction of the race, who may be deemed more fortunate, because more enlightened, we still encounter scenes scarcely less painful and perplexing. Not to speak of the falsehood and injustice, lust and pollution, which infest all ranks and conditions; how unaccountably mysterious are many of the dispensations of heaven itself! Toil, disappointment, disease and sorrow, constitute the lot of man in his most favorable circumstances. The lamentations of the unhappy are heard on every side. The world is truly a *vale of tears*. And this painfully mysterious aspect of the world has ever been a matter of wonder

to the good, and the foundation of much complaint and skepticism to the wicked. But the condition of our globe at this primeval period offers a suggestion that may be of profit to both.

To judge of the wisdom or goodness of Divine providence from the present aspect of the world, would be as if a spectator of the earth, in its confusion and darkness, had attempted to form an estimate of its appearance when finished and furnished complete. Who, looking on it then, would have supposed that the beauty of Eden would so soon stand upon its surface, with all its fair and enchanting scenery of hill and vale, groves and meads and murmuring streams, the happy abode of innocence and love? So of the moral world: this also is now in what may be called its *chaotic* or *transition* state. To us, the work appears but in its preparatory or incipient stage. We see only the beginnings of things. Providence is far from completing its plans. The gospel of the kingdom has not yet fulfilled its mission; mercy and grace have not accomplished their benignant designs. To understand and appreciate the symmetry and magnificence of the rising moral structure, we must wait till it is completed. The same mighty Hand and unerring Wisdom that at the beginning reduced to harmony, and reared to beauty, the confused and tumultuous elements of nature, will, in the fulness of time, disembroil the plans of Providence, and justify all his ways with man. As from the primeval chaos, when all lay in darkness without

form and void, there arose the world in its paradisiacal form and fashion, resplendent with the light of the sun, and decked with all the beauties of nature; so at last, from the heavings and conflicts of this moving sea of humanity, there shall arise a fair moral system, complete in all its parts, where God shall be seen all in all, and the whole intelligent universe admire the beauty of his moral character, and the grandeur of his sovereign control. As the mysterious drama of our fallen world shall close, "A voice shall be heard from every creature which is in heaven, and on the earth, and under the earth, saying, Blessing, and honor, and power, and glory, be to HIM that sitteth upon the throne! Great and marvellous are thy works, Lord God Almighty; *just and true are all thy ways*, thou King of saints."

The First Day.

The dense and darkening atmosphere is rarified, and Light is introduced.

THE FIRST DAY.

GEN. 1 : 3–5.—And God said, Let there be light; and there was light. And God saw the light that it was good: and God divided the light from the darkness. And God called the light Day, and the darkness he called Night. And the evening and the morning were the first day.

WITH these words commences the history of the *six days' creations.* In verse *first*, as before observed, the inspired Historian announces the absolute origination of the heaven and the earth; in the *second* verse, he describes the condition of our planet immediately prior to the Adamic creation; and at the *third* verse, he begins the account of the six days' work. In addition to the reasons already given in support of this interpretation of the sacred text, we may here observe, that the history of each of the succeeding days begins with this particular and set form of words, "And God said, Let," etc. It is but natural, therefore, to conclude that the narration of the first day's work begins with the third verse, where the same formula is employed, "And God said, Let there be light." Here, then, Moses enters upon the details of that stupendous process which perfected the earth as a habitation for man.

The globe having been thrown into a state of confusion and desolation, and the plants and animals of

the former epoch having been destroyed by the chaos, as described under the second verse, it pleased the Creator to occupy six successive days, to restore and furnish it, as the dwelling-place of the creature he was about to make in his own image. Few readers need be informed that the theory has been advanced that these days are not *literal days*, but *immensely long periods*. Much ingenuity and learning have been exercised in attempts to make the Divine Record countenance this idea. While we regard the great facts of geology as being established by proofs second only to the mathematical demonstrations of astronomy, yet we are constrained to say, that the method pursued to establish this interpretation does not appear to us to be plain and fair dealing with the Word of God; but rather a "torturing of the Book of Life out of its proper meaning." If the first chapter of Genesis can be made to mean what these theories express, other portions of Scripture can, with equal ease, be made to mean almost anything that the whim of man may desire, or his imagination invent. Here the point to be decided is, not what this Scripture can be *made* to mean, but what *does* it mean; what idea was it *intended* to convey? We believe that it means *literal and natural days*, for the following reasons:

1. No language could have been chosen more explicit, nor any terms found in the Hebrew more definite, to *express* literal days, than those here employed. There was a first day, a second day, a third day, etc., each

opening and closing with a definite evening and morning—literally rendered, There was evening, there was morning, day one; There was evening, there was morning, day two, etc.

2. Moses, who penned the record, we have every reason to believe understood these days, and meant that his *readers* should understand them as literal days; for we cannot suppose for a moment that he ever had in his mind anything like the ideas suggested by modern geology.

3. God himself refers to them as literal days in the commandment given from Sinai, "Remember the Sabbath day to keep it holy; for in six days the Lord made heaven and earth, the sea, and all that in them is, and rested on the seventh day." No impartial mind can read these words and come to any other conclusion than that the *six days*, as well as the *seventh*, were literal days.

4. There is no adequate reason for thus departing from the plain and natural sense of the record. The view we have taken of the chaos, under the second verse, does away with the principal difficulties, which made it necessary, as some have thought, to adopt the interpretation, that the creative days were so many *vast periods*.* If it be admitted, (and we have already seen what abundant reasons we have to admit,) that the condition of the earth immediately previous to the human period was that of a watery chaos, *a creation*,

* See pp. 58–64.

and such a creation as that here described, must have followed; for the present races of plants and animals must have been produced *since*. And as the highest geological authorities lay it down among their clearest and best established deductions, that the *present flora and fauna* (for the most part at least) were produced at the commencement of the human period, *the very date to which Moses assigns their creation*—why might not that creation, then, have been accomplished in six days? Wherein lies the difficulty of believing this? In other words, what is there to forbid the literal interpretation of this record?

On the first day it was said, "Let there be light; and there was light." Now, which is the more natural and consistent—to suppose that this fiat was followed by instant obedience? or by obedience that was slow and tardy, extending through an indefinitely long epoch? Is there anything improbable or unscientific in the idea, that, in obedience to this omnipotent command, as in response to a general discharge of electricity, the dense and darkening vapors which enveloped the globe were set in immediate commotion, dispersing, precipitating, and breaking up, *so as to permit light to penetrate from above?*

The history of the second day reads, "Let there be a firmament dividing the waters from the waters, and it was so." That is, Let there be established over the earth's surface a clear expanse, with the vapors collected into clouds, and floating, in appearance, as

another ocean over head. What is there in all this to forbid our believing that, as soon as it was said, it was done, and that in the day God commanded, it was established?

On the third day the fiat went forth, "Let the waters be gathered together, and let the dry land appear." Now, as has been shown, a comparatively slight depression of those portions of the earth's surface forming the beds of the oceans would effect all that is here imported; and geology teaches us that such subsidences had before taken place, sometimes slowly, and sometimes suddenly, times unnumbered; and not only that, but points to this *very period* as the date of certain *well-known depressions*. The literal interpretation of this chapter, however, does not require us to hold that the continents and islands were at once thoroughly drained, and covered with vegetation throughout their whole length and breadth, as we now see them; it is sufficient to believe that such tracts of them were made suitably dry on this day, as were designed by the Creator to receive the several species of the plants about to be created; while the process of draining over other vast regions might have gone on more or less slowly long after, till the passing waters sank, and became, for the most part, confined, as of old, within the banks of the ancient lakes and rivers. On these drier tracts of land were implanted species of the new-created vegetation, of a nature suited to their respective soils and climates; and from these, as so many centres, they

spread in every direction, till the surface of the globe, generally, was covered with them. Now, what is there incredible in the view that all this was done in a day? Nay, we ask, what has there ever been discovered in the sea, or on the land, that may not be explained in entire harmony with it? On the other hand, indeed, the supposition that this day was *a period of unmeasured and immeasurable duration*, does involve us, among other serious difficulties, in the grave one of holding that herbs, shrubs and trees flourished and blossomed, and matured seeds and fruits *in darkness, even ages before the sun had ever once shone upon the face of the earth*, for the sun did not appear until the fourth period.

On the fourth day "God made"—that is, appointed, not created—"two great lights; the greater light to rule the day, and the lesser light to rule the night;" of which we understand the meaning to be, that darkness having long enveloped the earth, God now fully restored the rule of the greater light over the day, and that of the lesser over the night, by clearing the firmament on this day into a pure azure sky, so as to disclose, for the first time, the *form* of the moon in her brightness, and the *orb* of the sun in his unobscured glory. And here we ask, again, what is there in the heavens above, or on the earth beneath, that renders it in any degree improbable that this clearing of the firmament was done in a single day?

On the fifth and sixth days, the sea and land were

peopled with living creatures. Now, while we take the record in its literal sense, we do not suppose that animals were created in anything like the vast numbers we see at present occupying the earth, the air, and the water. We are expressly informed that the human race have descended from a single pair, Adam and Eve; and each particular species of birds, beasts, etc., now living, however numerous it may have become, may have proceeded in like manner from a single pair. These original pairs, we may suppose, were created and placed on those tracts of land lying in climates, and planted with vegetation suitable to their respective natures; and from these centres, as they multiplied, they spread until the whole earth was peopled. And we ask, once more, what is there in all the domain of nature to deter us from believing that these various living creatures, in their respective localities, were thus created in one day, and in obedience to one and the same fiat? What difficulty is removed, or what advantage is gained, by supposing that their production occupied a period of unnumbered ages? Not any. We say, then, that there is no adequate cause or reason for thus departing from the plain and natural meaning of the record.

The fine "theories" and beautiful "visions" of mighty periods, that have been invented to relieve us of a few seeming difficulties connected with the sacred history, will be found, without exception, when duly studied, to involve more numerous and vastly more se-

rious difficulties, so far as the Bible is concerned. The remedies proposed are worse than the disease they are designed to remove. By forsaking the more simple and natural interpretation of this chapter, nothing is gained, much is lost, and everything is hazarded. These ingenious theories may have been wrought out from praiseworthy motives, and may have been presented on the altar of Revelation, under the impression that they were acceptable offerings; but the Word of God declines the oblations, and, as we believe, disclaims the necessity, and disapproves of the expedient.

While we thus hold the six days of creation to be days measured by so many revolutions of the earth on its axis, we may, at the same time, regard the WORKS done in these several days as standing *representative* of corresponding works done through all the preceding epochs of our planet's history. It may even have been the Divine *intention* that the works here described should thus symbolize all the operations of his hands that had gone before on the earth; and herein, perhaps, lies the reason why no account, no mention of former creations, is to be found in this chapter. For one event to stand, in this way, representative of another, is not uncommon in the Scriptures. For example, the passage describing the coming of the Son of Man in judgment against Jerusalem, in its full import, passes down to the close of time, and as truly describes his coming on the clouds of heaven to judge the world. In like manner the record of this chapter may, in its representative or sym-

bolical signification, run back and describe the doings of the Most High to the beginning of time. Now, geology claims that there have been numerous and successive creations; that new and higher species were repeatedly introduced at distant intervals. "Twenty-seven times," says D'Orbigny, "have distinct creations repeopled all the earth with plants and animals." The last of these creations, whatever be their number, by universal consent, was the Adamic, or that which took place at the commencement of the human epoch. Now, the description given of this last creation, so far as the Divine wisdom, power and goodness were concerned in its production, is a description of all the others. The words are perfectly true as describing the last creation, and the last creation is equally true as representing, those that went before. The account here given of the last elevation of the dry land at the Divine command, is a correct and truthful representation of all other elevations that preceded it. The description given of the last creation of fishes, of birds, of beasts, is, in like manner, a true and correct picture of all similar creations of fishes, of birds, of beasts, that had before taken place. And so of all the rest. The Mosaic record, therefore, taken in this light, is a true and real history of the whole creative work of God through all the epochs from the beginning.

While, to some, as we have just seen, six natural days seem too short a period for the accomplishment of the great work of creation, others there have been to

whom this space appeared *too long*. The representation that the work was done progressively, and not *instantaneously*, has been objected to, and declared unworthy of God. But such caviling can proceed only from equal ignorance and unbelief. The progressive plan was adopted, not to relieve God, but to profit man. Had the entire work of creation been accomplished in one instant, it would have been totally incomprehensible, and its history altogether useless, except as deciding the point, that the world is not eternal. In that case, the first verse would have contained the whole. But how much more interesting, comprehensible, and delightful is the record as it now stands. That the world was made by successive stages detracts nothing from the grandeur of the operation, or from the glory of the Creator. He who could do these things in the sublime manner here related, could have done them in any other way that pleased him. The history of creation, as we have it in this chapter, is the noblest history that was ever written by the pen of man. No history has been so much admired by critics, even from the time of Longinus to the present day.

And God said, that is, God willed. We are not to suppose that there was any vocal utterance. "God said" is equivalent to God willed. "His speaking is his willing, and his willing is his doing."

Let there be light; and there was light. A more literal translation would have been, Light, be; and light was. This sentence has always been admired by men

of literary taste as one of surpassing sublimity. It is to be observed, however, that its grandeur lies not so much in the words as in the *majestic idea.* God speaks, and it is done. He saith, Light, be; and, behold, light is, under the whole heaven!

And there was light. At the omnific command, the dense and impenetrable barrier of watery vapors, which had accumulated and rested down upon the face of the earth, enshrouding it in thick darkness, instantly began to clear away, and to permit the rays from above to penetrate and produce day—not a day of unclouded brightness, but as of the gray morning—a dark and heavy, and sunless day, for the body of the sun did not appear until the fourth day.

And God saw the light that it was good—good as fully and happily answering the ends for which it was at first made, and was now reproduced.

And God divided the light from the darkness—that is, appointed to each its place and duration, as determined by the revolution of the earth upon its axis.

And God called the light Day; and the darkness he called Night. Light and darkness were once more settled in such a constant succession, that distinct names were given to them.

And the evening and the morning were the first day. This is a Hebrew phrase denoting a whole day. The evening is probably mentioned first, because darkness preceded the light. On the ground of this recorded order of things, in the Sacred Book, the Jews reck-

oned their day of twenty-four hours from evening to evening.

The one great product of this day, then, now to be illustrated, is

LIGHT.

And God said, Let there be light; and there was light.

Of all the elements that occupy a high place, and exert an important influence, in the great laboratory of the universe, Light is the first and most remarkable. This, the issue of the first fiat of creation, presents to the inquiring mind, a series of wonders of the most sublime character. Over all, and through all, it spreads its etherial force, and manifests, in all its operations, powers and mysteries which may well inspire the soul with the most exalted and reverential wonder.

While we are acquainted with many of the laws by which light is governed, its essential nature is unknown. Some philosophers suppose that it is an *emanation* of inconceivably minute particles from the surfaces of luminous bodies, and that these act upon the retina of the eye, as odorous particles do on the nerves of smell. Others hold that it is the production of *undulations*, excited in a subtle ether pervading all space, which travel onward to the eye, as vibrations in the atmosphere do to the ear. Though long made the subject of unwearied study, and of endlessly varied experiments, the essential nature of light still remains a mystery.

In the record before us, light is put down as the *first* production in the creative process. Now this is the natural and necessary order of things, for the existence of light was a prerequisite to all that was to follow—to the functions of the waters, the salubrity of the atmosphere, the growth of vegetation, and the welfare of every living thing. Hence we see the philosophic correctness of the sacred narrative.

Light is the very life-blood of nature; without it every material organization would fade and perish. Where the influence of light is not, there death and silence hold supreme dominion. Light is indispensable to all life; the world was a dead chaos before its creation; and mute disorder would again be the consequence of its annihilation. Every beauty that adorns, every charm which spreads itself over this rolling globe, are directly dependent upon its radiations and luminous powers. It is the fountain of all our knowledge of the external universe, and through it we receive all the undefinable pleasures arising from the features of beauty, the grandeur of the landscape, and the glory of the heavens.

Light is essential to the *vegetable world*. Without it not a plant, not a grain of seed, not a blade of grass, could attain its designed perfection. It is true, indeed, that the vegetative process will go on in some sort, and to a limited extent, even in absolute darkness; but light is indispensable to the vigor, and to the useful and ornamental properties, of plants. When deprived of light,

all plants nearly agree in the qualities of their juices; the most pungent then become insipid, the most fragrant inodorous, and the most variegated of a uniform whiteness; and while vegetation that grows in a natural situation will *burn* when dry, that which has sprung up in a dark cellar contains nothing inflammable. We see, then, that to the agency of light, vegetation owes its taste, its smell, its color, and its inflammability, all important properties. So necessary is light to plants, that many of them will spontaneously throw open wide their flowers, and even exert a limited power of locomotion, bending towards it, in order to catch its vivifying influences.

Equally important is light to *animal nature*. Experiments of various kinds have proved this in reference to inferior creatures. And the due and constant influences of light are found very favorable to the regular conformation of the human body, and to the vigorous development of the mental faculties. Deformity and idiocy are most frequently found, and frightful diseases commit their most terrible ravages, in the ill-lighted habitations of narrow streets and northern exposure, where the salutary beams of light seldom, or in but scanty measures, shed their beneficial influence. A well-lighted apartment, and one commanding a southern view, is the most desirable, because the most promising, to the feeble Invalid. Reliable statistics prove that, in general, the chances of recovery in the well-lighted wards of hospitals are four to one, as com-

pared to the chances in dark or ill-lighted wards. "Light," says Dr. Child, "is one of the best and cheapest of nature's tonics; and unless it be habitually absorbed, neither animal nor vegetable can permanently prosper. Hence this needful medicament, by Divine arrangement, is poured out in daily streams upon the face of the whole earth." *And God saw the light that it was good.*

The illustration of many interesting properties of light will come in more appropriately under the *fourth day*, on which the great orbs of light were ushered in, which, therefore, we defer till we come to that stage of creation.

REFLECTIONS.

Analogies between the material and moral worlds are always traced by enlightened piety with equal pleasure and profit; and the work of this day presents us with an analogy of this kind full of interesting instruction.

The earth, even in its void and formless condition, floated and revolved in an ocean of light, which ceaselessly flowed all around from the great central sun; but the convulsions which it had suffered—the upheaving of the sea and the submerging of the land—had wrapped it in so dense an atmosphere of darkening vapors, that in vain the descending beams struggled to penetrate. Not a ray reached, or perhaps approached, its watery surface; unmitigated and universal darkness, therefore,

rested upon the face of the deep. This condition of the material globe presents us with a true emblem of the world of mankind, previous to the advent of the Sun of Righteousness. All here, too, was lying in moral darkness and disorder; the whole race was wrapped in deep spiritual night. The great enemy of man, Satan, had disturbed all the moral elements of the world—had, by the disruptive force of his instigations, everywhere upheaved and broken the even strata of social order and virtue; had submerged the precepts of the Divine Law beneath the turbid waters of ignorance and superstition; and had beclouded all correct knowledge of the true and living God in the corrupt exhalations of idolatry and lust. Placing himself between God and man, like the impervious clouds of ancient chaos, the great foe had sought, and sought with direful success, to intercept every beam from heaven; he had thrown his dark and hellish shadow athwart the whole globe, and the gloom of his presence had fallen like the pall of death over all human hope. No scene or circumstance in the history of our planet, save *the night of primeval chaos*, supplies an adequate emblem of the state of mankind at this time. As the brightest meteor in the midst of that dank and palpable darkness would have been invisible at the distance of a few fathoms: so found the Son of God himself amid the moral darkness that had invested the earth. "The light shineth in darkness," said He, "but the darkness comprehendeth it not," admitteth it not. So

ignorant, so debased, had mankind become, that they neither understood his instructions, nor appreciated his character. Here, as at the beginning, was darkness which omnipotence alone could dissipate.

Again: as in the natural so in the moral world, the work of illumination was to be *progressive*. Though light was introduced upon the earth on the first day, yet it was not until the fourth that the sun looked down from an unclouded sky, and illumined and animated with all his brilliancy the face of the new creation. And such appears to be the manner decreed for the moral enlightenment of the world. The light of truth introduced by Jesus Christ was not to effect the complete and permanent illumination of the globe all at once, but was ordained to grow brighter and brighter unto the perfect day—the day when its beams shall encircle and embrace the earth, and when He, by his spiritual presence, shall reign in a glorious manner over a redeemed, sanctified and happy world; our fallen race having become one vast, virtuous, peaceful family, and our distracted earth the seat of one grand, triumphant, and adoring assembly!

Bright and blessed prospect! But why should its consummation be so long delayed? Why did not the Sun of Righteousness complete at once the work of illumination in our benighted world? Such questions are not for us, the creatures of a day. With equal propriety we might ask, Why did not God bring forth the sun in his unobscured splendor on the morning of

the first day? or, why was our planet left without a human tenant through all the vast periods of the pre-Adamite earth? "Even so Father, for so it seemed good in thy sight."—Happy he, who, amid all the confusion of the world and the mystery of providence, is able to keep his eye and faith on HIM, who is at the centre of all the movements of the universe, and worketh all things after the counsels of his own will.

The Second Day.

The Firmament with its properties and functions is established.

THE WATERS DIVIDED FROM THE WATERS.

THE SECOND DAY.

GENESIS 1 : 6-8.—And God said, Let there be a firmament in the midst of the waters, and let it divide the waters from the waters. And God made the firmament, and divided the waters which were under the firmament from the waters which were above the firmament: and it was so. And God called the firmament Heaven: and the evening and the morning were the second day.

SUCH is the brief history given us of the great work of the second day; no particulars, no details are presented. We are favored only with the naked fact; that fact, however, brings before us for our study a series of phenomena of the most important and interesting character.

Let there be a firmament. The meaning of the Hebrew word here translated "firmament," is expansion, attenuation, elasticity, out-spreading, which are all terms expressive of the properties of the atmosphere. By firmament, therefore, we are to understand, not the starry heavens, but the whole mass of fluids, consisting of air, vapors, electricity and other matters, which immediately encompass the earth.

And divided the waters which were under the firmament from the waters which were above the firmament. At the Almighty word, the vast shroud of vapors which still hung over the face of the globe, was divided; part

was condensed, and fell in the form of rain to the waters that covered the face of the earth; and part was rarified, and ascended far above, forming clouds. And there "in the higher strata of the atmosphere, they lay, thick and manifold—an upper sea of great waves, separated from those beneath by the transparent firmament, and, like them, too, impelled in rolling masses by the wind."* Thus were the waters divided from the waters.

And God called the firmament Heaven. "Heaven," therefore, is of the same import as "firmament," and does not include the region of the stars, but that of the circumambient atmosphere only.

And the evening and the morning were the second day. The earth accomplished another revolution on its axis since the great work began.

From the foregoing exposition, it will be seen that this Day brings before us, for illustration, the various phenomena of the atmosphere—its mass and composition, its currents, its evaporating function, its electricity, its formation of snow and hail, and its office as a medium of communication—all subjects rich in exhibitions of the wisdom, power and goodness of the Great Architect of nature.

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* Hugh Miller.

THE ATMOSPHERE.

And God said, Let there be a firmament.

The atmosphere, like an ocean, overlies the whole surface of the earth; in fact, it is an ocean; and it is literally true, that, like crabs and lobsters, we live and move and spend our days at the bottom of a sea—an aerial sea. This atmospheric ocean rises far above us, and, like that of waters, has its waves, its currents, and its tides. It is found to grow more rarified, as well as colder, as we ascend towards its upper limit, which is supposed to be about forty-five miles above the level of the sea. Barometrical observations, however, show that on ascending to the height of three and a half miles, (nearly that of Cotopaxi,) we leave behind us, by weight, more than one-half the whole mass of the atmosphere. And from the experience of aeronauts, it is believed that there is no such air as man can breathe at an elevation of eight miles; probably death would be the certain consequence of exceeding seven, though some, of late, at great risk and suffering, have ascended to nearly that height. On the summit of Mount Blanc, which is a trifle under three miles, the sensations of those who make the ascent are very painful, owing to the levity of the air; the flesh puffs out, the head is oppressed, the respiration is difficult, and the face becomes livid; whilst the temperature is cold almost past endurance. At an elevation of fifty miles from the

earth's surface, the cold is calculated to be 132° below Zero, Fahr.

This ocean of air, like that of water, has also its *weight and pressure.* People, in general, are not aware, because they are not conscious, of any weight resting upon them from the atmosphere; yet reliable experiments prove that at the sea level it presses with a force equal to $14\frac{3}{4}$ pounds on every square inch, or 2,100 pounds on every square foot, or 58,611,548,160 pounds on every square mile; or on the whole surface of the earth with a weight equal to that of a solid globe of lead 60 miles in diameter! How few reflect that they live under an ocean of such stupendous weight! But to bring this fact more sensibly before the mind, we may state that the atmospheric pressure on the whole surface of a medium-sized man is no less than 14 tons—a weight that would instantly crush him, as hollow vessels collapse when sunk deep in the ocean, but for the elasticity and equal pressure of the air on every part without, and the counterbalancing pressure and elasticity of the air within.

The air encompassing the earth is a compound substance, made up of two gases, mixed in the proportion of twenty-one parts of oxygen to seventy-nine parts of nitrogen, by measure; mixed with these is a small proportion of carbonic acid gas, which does not exceed one two-thousandth part of the whole volume of the atmosphere. Whether the air is taken from the greatest depths, or the most exalted heights which man has ever

reached, this proportion of the oxygen and nitrogen gases is maintained invariably. The air on the summit of Chimborazo, or on the arid plains of Arabia, or on the pestilential Delta of the Niger, gives the same proportion of these gases as we find in that of the most temperate and salubrious countries of the globe. Considering the vast and varied exhalations that constantly ascend from sea and land, together with the incessant agitation of winds and tempests, this stands before us as a most astonishing fact, indeed! But it is not more wonderful than it is important. No possible change could be made in the composition of the air, without rendering it injurious both to animal and vegetable life. If the quantity of nitrogen were but a little increased, all the vital functions of man would be performed with difficulty, pain and slowness, and the pendulum of life would soon come to a stand. If, on the other hand, the proportion of oxygen were increased, all the processes of life would be quickened into those of a fever, and the animal fabric would soon be destroyed, as it were, by its own fires. Again, if, instead of the present proportions, these gases were mixed, two parts of nitrogen to one of oxygen, the result would be *nitrous oxide*, to breathe which for ten minutes would convert the whole human race into so many intoxicated maniacs, and the earth into one vast Bedlam or Pandemonium. Or, again, if two parts of oxygen and two parts of nitrogen were the proportions, the mixture would be *nitric oxide*, which is of so irritating a nature, that the glottis contracts

spasmodically when any attempt is made to breathe it. Or, once more, if the quantity of oxygen be still increased over the last-named proportion, we have *peroxide of nitrogen*, which is still more fatal to all living organization. Lastly, if five parts of oxygen were united with two of nitrogen, the mixture would be none other than *aqua fortis*, whose destructive properties are well known to all. We see, then, that out of a thousand possible proportions, one only is suitable to the nature of man and beast, and *that one* has been adopted!

Equal wisdom and goodness are displayed in the relative *gravity or weight* given to these gases. Oxygen is the principle that sustains life and combustion; nitrogen is incapable of supporting either. Immersed in pure nitrogen, both life and flame are instantly extinguished. Now, "in breathing, the air which is evolved from the lungs, at every expiration, consists chiefly of nitrogen, which is entirely unfit to be breathed again, and, therefore, has been made a little lighter than common air, so that it rises above our heads before the next inspiration. Had nitrogen, instead of being thus a little lighter, been a slight degree heavier than natural air, it would have accumulated at the surface of the earth, and particularly in our dwellings, to such a degree as to have produced diseases, pestilence and death, in rapid succession. But, as now constituted, it flies upward, and we never breathe it again till it enters into new and salutary combinations.*

* Christ. Phl., p. 35.

Oxygen, as it exists in the air, appears to be the mildest of all elements; it has neither taste nor smell, and seems to be devoid of all active properties. It bathes the most delicate plant and animal forms; it traverses the finest pores of flowers, and pervades the minutest cells of the lungs, without inflicting upon either the shadow of pain or injury. It seems to be perfectly bland and innocuous. Yet release it from the gossamer bonds which God has thrown around it, and it is one of the most powerful of the chemical elements. Beneath this apparent mildness there is concealed an energy so violent that, when once roused, nothing can withstand it. "A single spark will change its whole character, so that what seemed before inert and passive, becomes in an instant violent and irrepressible. The gentle breeze which was waving the corn, and fanning the browsing herd, becomes the next moment a consuming fire, before which the most enduring works of man melt away into air." How wonderful is this double character of oxygen! Who can sufficiently admire the skill of him who has thus united in the same element perfect mildness and immeasurable power!

REFLECTIONS.

On the *mass* of the atmosphere. Vast an appendage as this is to our globe, its dimensions and density have been adapted with the utmost exactness to the constitution of all organized existences. Any material change in its mass would require a corresponding change in the

structure of both plants and animals, and, indeed, in the whole economy of the world. If its mass were considerably reduced, all the difficulties experienced by travellers on the summits of lofty mountains, and by aeronauts at great elevations above the earth, would ensue; on the other hand, if much increased, opposite and equally disastrous results would follow. If the atmosphere had been twice or three times its present mass, currents of air would move with double or triple their present force. With such a change nothing on sea or land could stand against a storm. But how happily do we find all things balanced as now constituted. And how obvious, that, ere ever God had breathed forth the fluid air, in his all-comprehending Mind, its mass was measured and weighed, and the strength and wants of all living creatures duly estimated before one of them had been called into being. All the works of God have been done according to a determinate counsel and infallible foreknowledge.

On the *pressure* of the atmosphere. Contemplating the enormous weight of the air, resting upon all things and all persons, who but must devoutly admire both the wisdom and the goodness of the Creator, in so adjusting all the properties of the firmament, that under it we can breathe and walk and act with ease, unconscious of weight or oppression, while in fact we are every moment under a load, which, when reduced to figures, surpasses both our comprehension and belief. *Marvellous are thy works, Lord God Almighty!*

On the *composition* of the atmosphere. How very wonderful is this! When we reflect upon the proportions and combinations of its constituent elements, we cannot but look up with adoring reverence to its Divine Author. What wisdom, what power, what benevolence, have been exercised in arranging the chemical constitution and agencies of this world, to adapt them unfailingly to the strength and wants of animals and of plants, even the most delicate and minute! How very slightly the atmosphere of life differs from one that would produce instant and universal death! How trifling the change the Almighty had need make in the air we hourly breathe, to lay all the wicked and rebellious sons of men lifeless and silent in the dust!

THE WINDS.

He bringeth the wind out of his treasuries.

The infinitely minute particles composing the atmosphere, are in perpetual motion and circulation. These movements constitute the winds; and they all originate in a difference in the density of one portion of the atmosphere as compared with another. And this difference of density is caused by the heat of the sun, the presence of vapor, and at times, more or less, by electricity. When the air near the surface of the earth at any point is heated by the reflected rays of the sun, it expands and becomes lighter; then the surrounding

air, which has remained colder, rushes in, causing the warmed and rarified air to ascend. This motion of the colder air is Wind.

All this may be illustrated by a familiar occurrence. Let the door between a cold and a heated room be thrown open, and let a lighted candle be held in it. Near the floor the flame is strongly carried toward the heated room by the in-rushing current of cold air; but near the top of the door it is just as strongly driven towards the cold room by the out-going current of hot air. Precisely similar to what thus takes place between the two rooms is what takes place in the expanded firmament.

Bearing the above illustration in mind, what are termed *the sea and land breezes* will be readily understood. Let us take, for an example, an island standing alone in a tropical sea; remembering the fact that land heats more readily, and again cools more rapidly, than water. As soon as the beams of the morning sun begin to warm the ground, the air over it is warmed and rarified in proportion; the consequence is, the cooler and denser air which has been resting over the surrounding ocean, rushes in from all quarters, and the island is thus refreshed by a *sea breeze*. During the night the process is reversed. The island loses heat by radiation, and cools quicker than the sea; and its atmosphere with it having become cooler and heavier, runs along the surface in every direction into, or rather under, that of the ocean, and there is in this manner

produced a *land breeze*. By this beautiful balancing of the warm and cool air, the languishing inhabitants of the islands and seaboard countries of the tropics are daily refreshed and invigorated. In the East and West Indies these fannings of nature are said to be indescribably reviving and delightful.

What occurs between the two rooms, or between the sea and land air of an island, takes place on a grand scale between the whole equatorial regions of the globe and those of the poles. Here the polar regions correspond to the cold room, and the equatorial to the heated room. The air around the poles, being cold and heavy, flows along the earth's surface toward the equator; having reached the torrid zone, it becomes heated, and ascends to the higher elevations of the firmament, where it flows back over the colder air towards either pole, to begin again the same round. Thus two lower currents from the poles to the equator, and two superior currents from the equator to the poles, are in perpetual motion.

How, then, it may be asked, are the variable winds of the temperate zones to be accounted for? As the one current in its progress from the equator constantly becomes cooler, and the other in its approach toward the equator as constantly warmer, it follows, that at certain points they meet of equal weight and density, and thus encounter and impede one another; and this, together with the unequal temperature of sea and land over which they pass, and the influence of screening

clouds, electrical disturbances, and changes of seasons, produce the variable and ever shifting winds of the more temperate regions.

From the inferior and superior currents between the equator and the poles, result also the famous *Trades*, as they are called. On either side of the equator there is a broad region reaching to the 28th degree of latitude, where the wind blows regularly in one direction the year round. North of the equator, it comes from the northeast; and south of the equator from the southeast. These, from their commercial advantages, have been termed the Trade Winds. In the production of these, the earth's axial rotation exerts a controlling influence. The speed of this rotation in the immediate neighborhood of the poles is mere nothing; midway between the poles and the equator, it is over ten miles per minute; on the equator it is sixteen miles per minute. Now, as the cold current from the poles advances toward the equator, the surface beneath, for the above reason, sweeps forward with greater and greater velocity; so that the aerial current at every step of its progress falls a little behind-hand; that is, it is left a little further to the west than it otherwise would be. This loss goes on increasing, till the direction of the current from the north polar region is changed into southwest, and that of the one from the south polar region, into northwest. These two general currents from the northeast and southeast encounter each other in the torrid zone, and there combine, thus form-

ing a general current from east to west, sweeping across both the Atlantic and the Pacific.

The same cause makes the upper currents setting from the equator towards the poles, swerve in the opposite direction. The rotary motion in this case growing slower and slower, at each step in their progress toward the poles, they find themselves a little in advance of the earth's motion, that is, a little more to the east; so that by the time that the northern current reaches the middle regions of the temperate zone, its course is northeast, and the result a prevailing southwesterly wind; and when the southern current has reached a corresponding latitude, its direction is southeast, and thus gives a prevailing northwesterly wind.—How admirable the skill herein displayed, and how great the advantages secured! The very same combination of agencies which produce the Trade Winds, are made likewise by the Great World Builder to produce winds which blow in the opposite direction—thus providing for the adventurous mariner a propitious breeze both to go and to return on his distant voyages.

In the Indian Ocean the Trade wind is interrupted, and its course periodically changed, and from this circumstance receives the name Monsoon; from April to October it blows from the southwest, and from October to April, from the northeast. This change is effected in the same manner as that of sea and land breezes. While southern Africa, on the one side, is basking in the full heat of the southern summer, the

deserts of central Asia, and the high regions of the Himalayas, on the other side, are passing through the low temperature of their winter; hence the air rushes from this colder quarter across the Indian Ocean towards the warmer regions of southern Africa, thus producing the *northeast* Monsoon. The reverse takes place when Asia is heated by the burning sun of the northern summer, while south Africa is cooled by its winter; now the air blows in the opposite direction, and gives to India its *southwest* Monsoon. These winds also are great aids to navigation, as well as great blessings to the regions upon which they blow. In the southern part of the Indian Ocean, which does not come under the influences of these lands, the south-east Trade wind maintains its regular course through the year.

Other and peculiar agitations of the atmosphere occur in different parts of the globe, such as the Harmattan of the African desert, the Sirocco of Greece and Italy, the Typhoon of the China seas, the Hurricane of the West Indies, and the Cyclone which revolves across the ocean. Of these, the immediate causes in which they originate, and the specific ends they are designed to accomplish, are for the most part equally obscure. But of this we may be sure, whatever incidental evils may attend them, that, like all the other cosmical arrangements, they are ultimately beneficial to the world. Winds are "nature's most efficient sanitary agents, by which she renovates the air that has become tainted

through stagnation, and scatters the seeds of the pestilence that are growing up for destruction."

REFLECTIONS.

The foregoing subject may serve to teach us that all the works and ways of God, however discordant or disconnected they may appear, are founded in wisdom and designed for good. To the uninformed nothing seems more uncertain, capricious and irregular than the times and courses of the winds; "fickle as the wind" has become a proverbial expression; yet, as we have just seen, all the agitations and movements even of the *wind*, are governed by forces most delicately balanced, and acting according to the most infallible laws of nature—the constitution of the atmosphere, the form of the earth, its velocity on its axis, the cold of the Poles, and the heat of the Line, are all so regulated and fitted into each other, as to encircle the world with a magnificent and perpetual system of ærial currents, essential to the welfare and convenience of its whole population.—The same holds true in the moral world. With our present limited and imperfect knowledge, many things in the lot of individuals, in the condition of nations, and in the government of the world, may appear to us irreconcilable with a just and wise Providence. But this is our ignorance. Were we permitted to look outward from the great Central Throne, and could understand the relation of the agencies employed, and the connection of the ends to be accomplished by

the Divine administration, we should see that, as with the wind, what now appears a mass of discordant agents, disconnected actions, and fortuitous results, were all necessary and fitting parts of a harmonious system, and that every actor, every influence, every event, was brought forward in its intended connections, and at its appointed time. Such knowledge, *now*, is too wonderful for us; it is high, we cannot attain unto it.

In the Hebrew, and also in the Greek Scriptures, the same word denotes both *wind* and *spirit;* hence the former is often employed to illustrate the operations of the latter. The most notable lesson of the Great Teacher on the subject was conveyed under this comparison. As the wind *cannot be seen*, but is known only by *its effects*, waving the vegetation, agitating the waters, or driving the clouds, so also the Spirit of God in his presence with men. No man hath seen the Spirit at any time, but we are as well assured of his existence, and of his gracious agency, as if we beheld him with our eyes; for we plainly see his effects, making the thoughtless serious, the profane prayerful, the proud and passionate meek and mild, the afflicted calm and peaceful, and the dying triumphant over death and the grave. As every effect must have a corresponding cause, these are as surely the fruits of a Holy Spirit as that the waves of the sea, and the motions of the clouds, are the effects of the wind. Happy the soul that has *known* his renewing power!

EVAPORATION.

And God divided the waters which were under the firmament from the waters which were above the firmament.

This division of the waters was the most prominent feature of the second day's work. The process employed for its accomplishment, we may suppose, was that of evaporation. By this agency the dark and dank vapors were made to rise, and suspend themselves in clouds in the higher regions of the atmosphere, and thus leave a clear expanse or firmament over the face of the earth. And this agency, now called into such active exercise, was to remain in permanent operation, being indispensable to the welfare of the world, as without evaporation there could be no clouds, without clouds there could be no rain, without rain there could be no vegetation or animals, and without vegetation or animals there could be no men.

For the better understanding and appreciation of this wonderful process, let us suppose that it has never yet rained, that even a cloud has never been seen, and that under these circumstances the human family is placed upon the earth, and appointed to subsist upon what shall grow out of its soil. Soon they discover that moisture is indispensable to all vegetation, and that unless the ground be watered, it will yield them nothing. Immediately upon this follows the inquiry, How is this to be done? There, indeed, is the deep and wide sea—

an abundance of water; but here is the land rising far above its level. How can that water be raised hither, and how is it to be freed from its saline impurities, so as to be fit for the use of man, or beast, or the field? How is it to be drawn from its deep places, and carried in adequate quantities over the length and breadth of the plains, or hoisted and dispersed over the hills and mountains? And how is this to be done perpetually, at the needed intervals, and in sufficient amounts for every region of the earth's surface? Who that had never seen a shower or a cloud could have answered these questions? Who, in such a case, could have solved the alarming difficulties which they present? The happy and effective method contrived by the Great Architect would never have entered the human mind. Let us, then, contemplate the system of beautiful adjustments by which our FATHER accomplishes all this for us, without labor, or assistance, or care on our part.

Our first inquiry is, *How is the water of the ocean to be raised and freed from its salts, for watering the earth?* By evaporation; and this is a wonderful operation. Water, in its natural state, is 800 times heavier than atmosphere; and but for our experience, that such a weighty element should rise and float in thin air, would appear to us as unlikely and impossible as that the gravel at the bottom of a lake should rise and swim on its surface. Yet God contrived a method by which this is effected with infinite ease every day. In what

way, then, does water climb into the firmament, and float at the rarified altitudes of three or four miles, and even six miles, where cloudlets are sometimes seen? The atmosphere is so constituted as to be capable of absorbing moisture and retaining it in an invisible state; the warmer the air, the greater is its capacity for this. The air in a room measuring sixty feet each way, and at a temperature of 68° Fahr., is capable of taking up and holding no less than 252 pounds of water. Now, by the action of heat, water is converted into steam or vapor; and, in this state, it occupies a space 1600 times greater than in its liquid state, and is, therefore, much lighter than the atmosphere; consequently it readily floats and ascends into its higher regions. In this way vast quantities of water, in the form of invisible vapor, are continually ascending from sea and land, and even from the regions of perpetual ice and snow. This vapor, having reached the higher and cooler altitudes of the firmament, gradually condenses into visible clouds, which are sometimes thousands of feet in thickness, and tens of thousands of acres in extent, and suspend in their dark folds immense quantities of water, ever ready to return to the earth from whence it arose. But if the water raised in this manner were to drop back on the spots from which it was produced, but little or no good would be effected. Hence arises

A second question, *How is the water treasured up in the clouds to be conveyed where it is needed?* What arm can reach and impel their mighty masses to the distant

plains and the rising mountains? To no purpose has the machinery of evaporation been contrived and set in motion if this be not done. Vain, indeed, is the strength of man here. But just at this point another of the atmospheric agencies is brought into happy operation. The beautiful system of air-currents or winds, described in the preceding chapter, pursuing their appointed courses, load themselves with the clouds, and upon their untiring wings bear them away hither and thither, as they are needed. A ship loading with merchandise at a foreign dock, or a train starting with freight from a railroad station, is not more explicit in its mission, than the currents of the atmosphere, which take in from sea, and lake, and river, cargoes of vapor, and hasten with them to the waiting isles, and to the hearts of continents, where we see them float their enriching stores over the dry and thirsty land. But these treasures of moisture, however suitable in their nature, or ample in their quantity, suspended at an elevation of two, three, or four miles, if they remain there, will be of no more benefit to the toiling husbandman, than so many barrels of provisions laid up in the moon would be to the famishing mariner. Hence springs

A third question, *How are these nebulous ships to be unloaded?* How is the water to be released and brought down from the clouds? What can man do or contrive to effect this? Nothing. What, though by his skill he has learned to ascend into the sky? What if he should construct a fleet of balloons, and dispatch

an army thither? Could they besiege those towering masses, and compel them to let go their watery stores? or could they lay hold upon the skirts of those clouds, and pull them down into contact with the panting earth? No; none of these. Here is work above the power and beyond the skill of man. As water is converted into vapor by heat, so by the loss of heat vapor is reconverted into water. Hence, when a cloud of vapor, either by entering a chillier stratum of air, or by coming in contact with colder currents, loses any portion of its former heat, a corresponding proportion of its aqueous contents is condensed into what may be called *water-dust*. And these dust-like particles, by coming into contact, unite; and these again, in a similar manner, coalesce with others still, till visible globules or drops are formed. And all this process is conducted with the exactness of number, weight and measure. A cloud, for example, floats in a current of air of 80° temperature; if that current loses 9° of its heat, the cloud must cast overboard, in the form of a shower, *one quarter of its load*; and if it loses 21° of its heat, then it must part with *one-half of its tonnage*. Thus, as the heat gradually decreases, the condensation of the vapor gradually increases, forming, as just stated, the drops and the showers, which refresh and renew the face of the earth. And this brings us to

A fourth arrangement of great moment and pleasing interest, *The admirable way in which the clouds discharge their contents, viz., in soft and gentle showers.*

If, instead of this, they poured out their prodigious contents at once, in streams and floods, the consequences, frequently, would be destructive and lamentable in the extreme, as is evident from instances of this kind, which, at distant intervals, have taken place. Vegetation would be destroyed, crops would be beaten into the ground, the trees stripped of their leaves and fruits, the fields ploughed into trenches, and the soil washed away, the streams suddenly swelled into impetuous and destructive torrents; so that presently every gathering or passing cloud would become like an avalanche, an object of terror to all who beheld it. Viewed in contrast with all this, how beautiful, how beneficent is the existing arrangement! Instead of descending like this, in ruinous cascades, we see the water trickling down in gentle and fertilizing drops, as if the nether side of the clouds were finely perforated into a sieve, and these drops alighting upon the earth, without bruising a flower or destroying a blade of grass. Softly the work begins, and softly it is carried on as the cloudy cisterns sail slowly over field and forest, hill and dale, leaving no district unvisited, no spot unwatered. Who that intelligently contemplates all this, but must be rapt into admiration and gratitude, in view of the designing wisdom and diffusive goodness of God, as seen in every passing shower!

The work of evaporation and condensation is conducted so gently, so noiselessly, and, for the most part, so unobserved, that but comparatively few are aware

of the stupendous magnitude of these operations. The quantity of water which is annually condensed and deposited as *dew*, in Great Britain, has been estimated at five inches. In temperate climates, like that of Europe, with a mean temperature of 52°, the annual evaporation is equal to a layer of water thirty-seven inches deep. Within the tropics it is much greater, varying from eighty to one hundred inches. Take another fact: the Dead Sea is an inland sheet of water, seventy miles long by twenty miles wide, having no outlet. Into this discharges the celebrated Jordan, which, at its mouth, is 250 feet wide, and ten feet deep, and flows with a current that discharges daily over six millions of tuns of water. This influx has been going on, without intermission, year after year, and century after century; yet this lake neither rises nor overflows the surrounding country, but remains the same to-day that it was in the days of Moses and Joshua. And by what means has it been kept within these same fixed limits? Obviously by evaporation, for its waters have no other way of escape. The same holds true of the Caspian Sea, and the Sea of Aral. And what is true of these is true of all the great oceans. Hence it follows, startling and incredible as the statement may at first appear, that as great an amount of water daily flows upward by evaporation into the skies, *as all the rivers of the globe pour into the ocean*, which has been computed to amount to 186,240 cubic miles per annum! a quantity sufficient to cover all the land of the earth to

the depth of three feet. Such are the results accomplished by the machinery of the firmament, which, under all its tremendous weight of labor, never wears out, never breaks down, never fails to do its work at the right time, and in the right way.

The invisible moisture of the air, supplied by evaporation, besides watering and nourishing all the vegetation of the earth, is essential to the welfare, and even to the life of everything that hath breath. Were the air at any time to become perfectly dry, it would, in its eager thirst, suck up all the fluids of our bodies, and speedily convert them into blackened mummies. Add to this the fact, that from the moisture existing in the air, the atmosphere derives its power of confining the heat, which is always endeavoring to radiate from the earth's surface into space; through a perfectly dry atmosphere this heat would freely and rapidly escape, so that but for the moisture present in the air, every night would place the earth's surface, as it were, in contact with that intense cold which exists in empty space —a degree of cold proven to be not less than 230° below Zero, Fahr., in which no earthly plant or animal could live even for an hour. Our safety—the safety and well-being of every living thing—depends on a free admixture of water with the air. How marvellous and how beneficent altogether, then, is the process of evaporation, *the dividing of the waters from the waters!*

REFLECTIONS.

In the foregoing subject we behold striking evidences of the unity of the Creator's plan, and the harmony of all the agencies embraced in it. Our reason is delighted, and imagination charmed, in contemplating the physical arrangements of our world from such a point of view as that we have just been occupying; from it the atmosphere, the ocean, and the dry land, appear each as a part of that grand machinery upon which the well-being of all the living tenants of the earth depends; and which, in their connections and beautiful adaptations, afford the most convincing proof that they all have had their origin in one Omniscient Mind, just as the several parts of a chronometer may be considered to have been contrived and made according to one human design.

Vast amounts of toil and treasure have been expended to supply cities with water; and the aqueducts and hydraulic machinery constructed for these ends stand among the greatest of human achievements. Shall we point to one of these—a mere toy, bearing its scanty measure to a single group of humanity—as a monument of skill? and shall we deny or overlook the skill and power Divine displayed in the self-acting, and self-perpetuating water-works of the firmament, which so abundantly supply the wants of a whole world's population, refresh with showers the vegetation of its four continents, and keep in perpetual flow their springs and

streams and rivers all? Can any being, claiming intelligence, view all this, and not instinctively adopt the devout language of the prophet, "He that thus calleth for the waters of the sea, and poureth them out on the face of the land, JEHOVAH is his name."

And the *scenery* of the firmament—how much do we behold in this to admire and delight. What forms, what colors, what variety, what movements and magnitudes! How excellent the arrangement that, instead of leaving the rising vapors to overspread and obscure the whole heaven, breaks up and collects them into clouds, thus exhibiting to our delighted eyes "the blue etherial sky," and producing the pleasing alternations of shade and sunshine! How charming the lights and shadows that are thus made to flit over the face of the landscape; now we see the sun suddenly bursting forth from his hiding-place, and flooding all nature with his genial heat and glories; and now we witness the deep gigantic shadows of the flying clouds, careering, one after another, over field and forest and mountain-side! Add to all this the endless combinations and shades and forms the clouds are made to assume, in order to relieve and adorn our skies. We have the delicate tints that first streak the morning sky, spreading and deepening, spreading and deepening, till the whole roof above is wreathed and lined with purple glories! Then we have the silky vapors that, at the fervid noon, float in the highest azure, as if the altar-smoke of pure devotion on its way before the Highest. And, again,

the clouds of thunder; these, at first sombre in color and limited in extent, soon begin to swell and put forth glistening fronts, and divide into chasms and precipices; massy and almost motionless they stand, only piling, with every instant, higher and higher into the sky, till mountains of marble, and pinnacles of glittering adamant are presented to the view, casting far behind them their deep, dark shadows. Above all, we have the scenes of the setting sun. Amid what indescribable glories often sinks to rest the great monarch of the day: declining in his westward course, what manner of clouds await him, calmly resting on the verge of the horizon; slowly he descends, and softly amid their resplendent folds he sinks—disappears; and lo! over his couch is drawn a veil of purple and crimson and scarlet, more gorgeous than the curtain of God's tabernacle, and all glorious to behold! And this, all this, was contrived to gratify the eye, to inspire the imagination, and to fill with cheer and delight the hearts of the children of men.

In this system of evaporation, clouds and showers, we have an instructive *type of prayer* and its gracious returns. In the natural world, the sun pours down his light and heat, and diffuses his genial influences over all; yet warming and animating, in a special degree, those fields and hill-sides turned more directly towards him, and drawing upward from them a proportionally greater amount of vapor; this vapor, as we have seen, in due time, returns in showers, refreshing and beauti-

fying all nature. So in the world of Christian devotion. Under the benignant beams of the Sun of Righteousness, the exhalations of prayer and praise are drawn upwards to the heavenly throne; more abundantly, as in nature, from those more completely under his gracious influences; and these exhalations of the heart, through a Saviour's mediation, are made to return in richer showers, even showers of grace, to refresh and strengthen those souls to bring forth fruit unto everlasting life. Again: As the earth, without showers, would soon become parched and barren and dead; so, without the rain and dew of Divine grace, the moral earth would become as iron, and its heavens as brass; every plant of holiness, every flower of piety, and every blade of virtue, would soon droop and die. Nor does the parallel end here: as in the physical world, the greater the quantity of vapors drawn up from sea and land, the greater will be the amount of rain that sooner or later will come down on plain and mountain; so in the spiritual, the more abundant the exhalations of prayer and supplication from the children of men, the more copious the showers of grace that will be poured out in return. Let prayer, therefore, daily ascend as the vapors from the ends of the earth, and rise as clouds of incense before the throne, and this wilderness shall yet blossom as the rose, flourish as the garden of the Lord, and bloom with all the beauties of an unblighted paradise.

THUNDERSTORM

LIGHTNING AND THUNDER.

He made a way for the lightning of thunder.

Another element of great and mysterious interest pertaining to the firmament is *electricity*, whose presence and effects are most commonly witnessed in thunderstorms. This subtle principle appears to be diffused through all nature; the firm earth, the rolling ocean, the yielding atmosphere, the bodies of living animals, and the substance of growing plants, alike confess its presence. It is, beyond all doubt, one of the most important of the forces of creation. Its power is all but omnipotent. In an instant, it rifts the oak into splinters, sets floating ships in a blaze, and explodes the massive castle into fragments. Even rocks have been scathed and vitrified, and the hardest metals reduced to fluids, by this terrible element in its furious march.

The nature of electricity is involved in much darkness. By some philosophers it is believed to be a *form of heat.* It is supposed to be of two kinds, or, at least, to exist in two different conditions, termed *positive* and *negative.* Positive and negative electricities always exhibit a powerful disposition to unite; but two bodies, charged with the same kind of electricity, whether positive or negative, repel each other.

Electricity may be generated and collected by artificial means; as by rubbing a revolving plate of glass with a piece of silk. After a manner similar to this,

Nature herself is constantly carrying on the same process on a grand scale. The currents of air are ever generating electricity as they sweep or rub over the surface of the globe; and the fluid thus evolved passes partly into the earth and partly into the atmosphere. When very dry, the portion passing into the air may accumulate in excess, in which case the firmament becomes filled with thunder-clouds, from which dart flashes toward the earth; or, sometimes, from one cloud to another; and in this way the equilibrium is restored.

The phenomenon of a thunder-storm may be explained by a simple experiment. Let a glass globe be suspended by a silken cord directly over a table; let this globe be charged by means of an electrical machine with *positive* electricity, and immediately this acts inductively through the air, and causes a counter-collection of *negative* electricity in the table below. These collections, as just stated, have a strong tendency to unite; if the intervening space, however, be considerable, this they cannot do. But let the glass globe be now gently lowered so as to lessen the interval, and the electricities, able now to overcome the thinner partition of air, rush together with a spark and detonation. Now this spark and detonation are thunder and lightning in miniature, and are precisely similar to these sublime phenomena as witnessed in the heavens. *There*, a cloud becomes impregnated with positive electricity, and this will throw a neighboring cloud, like the table,

into a negative state; and the instant these two clouds are brought sufficiently near, there is a disruptive discharge from one to the other, attended with a startling blaze of light, followed by a crash of thunder, produced by the concussion of the air in re-uniting, after having been divided by the electric discharge.

It frequently happens that a cloud of many thousands of acres becomes charged with positive electricity; this, floating along at a low elevation, renders a corresponding extent of the earth's surface below negatively charged; and all within the borders of this negative tract find themselves almost helplessly stationed between two highly excited masses; the air becomes sultry and stagnant; the head is oppressed with dulness, and the whole frame with nameless languor. The very beasts become living electrometers; the animated horse and the dull ox alike stand in rueful gaze, and the birds skim low along the ground, as if dreading a loftier flight. The wind comes and goes in fitful gusts, or lowly moans, as if bewailing the approaching conflict. Stillness and gloom invest all nature. As this storm-cloud sails onward through the atmosphere, its negative electrical antagonist, like its shadow, is travelling the surface of the ground at the same pace; between them is kept up a contest, like that of armies moving in parallel lines; ever and anon the vivid flashes dart forth, or the red bolts are hurled from above; the very ground trembles, and the whole concave reverberates with the clangor of the mighty discharges, while the

copious shower descends, as in an unbroken sheet, to lave the face of nature.

What are commonly called *thunder-clouds* are not the only depositories of electricity in the atmosphere; even the *cool mist*, which settles down upon the earth's surface, is frequently charged with enormous quantities of electricity. Experimenting upon such mist in the month of November, Crosse, the English electrician, drew from it such a rush of electric fire, that the eye could not endure to look at it; and to have touched the conductor through which it gushed would have been instant death! For upwards of five hours, this splendid, but appalling spectacle, continued without intermission. In every acre of that fog, he tells us, there was enough of accumulated electricity to have destroyed every living thing within that acre. How startling to think, that in travelling through a raw autumn mist, we may be sheeted in fire, and passing through a furnace more deadly than that of Nebuchadnezzar, and yet escape without a hair of our head being singed!

It is pleasing to contemplate what provisions the Creator has made to prevent danger and destruction from an undue accumulation of electricity in the atmosphere. He has so constituted every tree, every bush, and every blade of grass, as to be a conductor of electricity from the atmosphere into the earth. "A leaf pointed with nature's exquisite workmanship is three times as effectual as the finest needle; and a single living

twig far more efficient than the metallic points of the best constructed rod. What, then, must be the agency of an extended forest in disarming the storm of its terrors? The raindrops and the snow-flakes, also, have been made good conductors; so that during the storms, a bridge for the lightning is thrown across from the clouds to the earth. Hence we see with what care Providence has guarded us from this destructive agent. It is only under unusual circumstances, when electricity is developed more rapidly than it can be dissipated through these numberless channels, that a violent discharge takes place; and if, then, it tears, burns or kills, it also reveals the merciful Hand which constantly spares."—*Cook's Religion and Chemistry.*

We have used the term *undue* accumulation of electricity—this is not strictly correct, for even this excess is a specific arrangement, and is designed to effect important results. It is when the volleys of the bursting cloud cleave the firmament, and the thunders of the discharge are pealing their dreadful notes above our heads, that the chemical combinations of the noxious exhalations arising from decaying animal and vegetable substances, are effected, and the elements, fitted for the purposes of animal health and vegetable growth, are formed and brought to the ground in the heavy rains which usually attend these storms. It is by these convulsions that the atmosphere regains its balance, and renews its salubrity. Thus Science unites with Revelation in teaching us, that our Father in heaven is no less

loving and kind in launching forth the "winged bolt," than in sending down the gentle sunbeam.

REFLECTIONS.

God is not nature, and nature is not God; yet whatever of wisdom or wonder, of goodness or excellence, nature displays, existed in the Divine mind from eternity; and the end of every created thing is to be, so far, a manifestation of the Creator's perfections. And no production of his hand, perhaps, speaks to us more plainly and impressively of these than the electric element. The wonders wrought by its power are truly marvellous, and many of its magic influences have, thus far, baffled every attempt to explain or understand them. The dewdrop that glistens on the flower, or even the tear that trembles on the eyelid, holds locked in its transparent cell a sufficient amount of this electric fire to create a storm that shall be felt and heard over a kingdom. It exercises power and dominion throughout nature. It pervades the bodies and affects the lives of all animated beings, and is concerned in the growth and maturity of every vegetable production. Its currents trace the circumference of the globe, and its vibrations reach to the depths of its centre. The precious metals shut up in the rifted chasm, and the glittering gems hidden in the darkness of the solid rock, are indebted for their value and brilliancy to its potent influence. And while this element moves thus on its appointed errands with the velocity of thought, and has

power to rend the heavens, and shake the mountains, yet we find it so safely curbed and restrained, that for the most part, it floats around our path innocuous as the gentlest zephyr. Who that intelligently contemplates all this, but must also admire and adore its Divine Author!

Awe and reverence are not the only lessons taught us by this mysterious element. Let us again trace it in one of its more familiar operations. The day opens bright and warm; its earlier hours pass full of promise. But presently its sky begins to be invaded by unlooked-for clouds; these roll up, expand, and soon overspread the whole heaven; the sun is shut out; omnious gloom pervades the expanse. And now startling flashes gleam through the massy clouds, or fiercely dart down to the earth. Rain and hail descend commingled; and fitful winds unite with thunder to add to the terror of the scene. For a time disaster and destruction seem to threaten all. We wait in dread suspense. At length the storm has spent its force, and dies away. Look now abroad, and survey the consequences. Lo! what a happy transfiguration of all nature! The sultry and oppressive atmosphere is gone. The sun shines forth with softened splendor. The air has recovered its healthful spring and life. The foliage glistens with golden drops, and the landscape, refreshed by the copious rain, laughs in every part at those dread storm-clouds now fading on the distant horizon. Nature lifts her drooping head, and, shaking the moisture from her

foliage tresses, smiles as beauty does through its bridal tears, to see her fair world blessed and renovated by the storm. So, reader, it is also with the storms of life. These, in like manner, however they may startle or dismay, are sent in mercy—sent to clear your moral atmosphere, and to restore health to your soul. And the tempest which you think you see even now gathering on your horizon, and which so much alarms you, may be charged by the Sovereign Ruler of all to bear for you under its dark wings a benefit, a blessing, that you know not of. He that sitteth above the heavens often extracts from the blackest clouds the most refreshing drops of mercy, and from the furious tempest evolves the happiest results.

SNOW AND HAIL.

He giveth snow like wool, and casteth forth his ice like morsels.

Snow and hail, like the rain, come down to us from the great laboratory of the firmament. Snow consists of vapors frozen while the particles are small; in other words, it is crystallized water. When a flake is examined through a magnifying glass, the whole of it appears composed of fine, shining spicula, diverging like rays from the centre. As the flakes descend through the atmosphere, they are continually joined by more of these radiated spicula, and thus increase in bulk, like the drops of rain. They are of various forms, all very beautiful after their kind. They differ in size from

SNOW FLAKES.

SNOW FLAKES.

one-third to one-thirtieth of an inch in diameter. Snow occurs in all regions of the globe at a certain height above the level of the sea; but it falls more abundantly on plains as we proceed from the equator toward the poles.

Hail is a more compact mass of frozen water. These congealed drops assume various figures—round, pyramidal, flat, angular, and sometimes stellated with six radii, like a small crystal of snow. When hailstones are broken open, they are sometimes found within to be of a spungy structure; sometimes the interior presents a very beautiful radiated appearance; and, not unfrequently, exhibit regular and very remarkable concentric plates. They vary in size from that of a grain of mustard to masses an inch, and sometimes two inches, in diameter.

These frozen meteors, like everything else, have their use in the economy of nature. Snow is a beneficent provision made for the benefit of the higher latitudes of the earth, where the winters are severe. Extreme cold being destructive to vegetation, God appointed that the vapors which, in summer, unite their particles and fall in rain to refresh and nourish all the vegetable tribes, should, in winter, descend like soft wool to cover and protect them from injury from the extreme cold. Though cold in itself, yet by settling into a compact layer, it prevents the internal heat of the earth from escaping. Careful observations have shown that the lower surface of the snow seldom falls much below 32°

Fahr., although the temperature of the air outside may be many degrees below the freezing point. It thus forms a safe covering to the more tender herbs, till the rigor of winter gives place to the genial influence of spring. But for this provision many regions of the earth that are now peopled would be uninhabitable, as nearly all vegetation would be utterly destroyed by the intensity of the winter's cold. To all this we may add the fact, that the nitrous particles contained in snow are said to be of a fertilizing quality, and to benefit vegetation.

REFLECTIONS.

From the least to the greatest, the works of God are worthy of himself. The snow-flakes that fall upon our path speak their Maker to be a Being of infinite perfections. See yonder fleecy cloud approaching, extending for many miles in every direction, and showering upon the land its downy flakes in unnumbered millions: every one of those flakes, countless as they are, has been formed after its proper model; each particle has its precise place and position, and every point its proper acuteness and direction. These beautiful little snow stars present us with a variety of forms, while every one is of a figure and symmetry perfectly geometrical. Some have three sides and angles, some six, some eight, and some more: some are like sparkling crosses, and some like the leaves of open flowers; some appear like single stars, others like a cluster of stars arranged in the most beautiful order. Each flake is

formed with nothing less than art and skill Divine. Although all may be destroyed by half an hour's rain or sunshine, yet not one has been neglected, not one has been slighted or imperfectly formed. Every one of the myriad myriads that cover the earth in winter has been fashioned with as much correctness and beauty as if expressly designed for examination: and every one attests the presence and agency of the Divine Being in its formation.

To the enlightened and devout mind, every season has its charms. Even mid-winter has its peculiar interests to the Christian student. How beautiful is the face of nature when the morning sun rises clear upon a country embosomed in snow! How delightful to behold the hills and the valleys mantled in pure white, and reflecting the sun-beams, in varied tints, from a thousand points. How beauteous the grove, and each particular tree robed in fleecy whiteness, and sparkling beneath the early sun; and the icy bosom of the lake and the stream, like mirrors, receiving and reflecting the images of the rocks and the hills, and of the flying clouds and bending trees! What a delightful combination of objects! What a splendid and dazzling array does the earth now present! O Lord, truly "the rolling year is full of thee!"

THE AIR AS A MEDIUM.

And God saw the firmament that it was good.

Besides the wonderful properties and functions at which we have looked, the atmosphere is the appointed medium of many other inestimable benefits to the world in which we live, which we can but barely mention.

While the sun is the great source of light, yet the co-operation of the atmosphere to diffuse that light is essential to the proper illumination of the earth. To the atmosphere we are to ascribe the sweet glories of the day, the delicious blue of the heavens, and the soft and soothing shades of the landscape. Without it the sky would be black as ebony, and out of it the sun would gleam like a red-hot ball; and his beams, like a ray passing through an aperture into a dark room, would reveal only the objects on which they fell, or those from which they were directly reflected. Without atmosphere there would be no twilight, morning or evening; the sun, at the commencement of day, would, at one bound, burst from the bosom of night in all its unbearable brilliancy; and, at the close of day, would suddenly plunge out of view, and leave us at once in utter darkness. To the atmosphere we owe all the glories of the setting sun, when heaven puts on her most gorgeous robes, and for all the loveliness of the softening twilight that succeeds.

By means of the atmosphere birds wing their way

through space, and insects flit from flower to flower. Without it the busy bee could never gather and lay up her nectar store, or the morning lark ascend on high to pour forth her early song. Without it even the eagle and the condor would flap their wings in vain; flight would be impossible.

The atmosphere is also the vehicle of *smell*, by which we are warned of what is unwholesome or offensive, and attracted to what is desirable and pleasing. Without it we should never be regaled with the perfume of incense, or the sweet odors of flowers from garden or field.

The atmosphere is likewise the medium of *sound*. In its absence eternal silence must have reigned; conversation could have been carried on by signs only, while music would have remained an impossibility—that is, supposing that, under such circumstances, men could have existed to converse or sing. The vibrations of the air, like speedy messengers, are what convey our thoughts to others, and those of others to us. The air is the channel through which man holds communion with his fellows, and receives the indescribable pleasures that spring from the words of friendship, the voice of love, and all the soothing charms of melody.

REFLECTIONS.

There is a theology in nature as well as in the Bible, and these two, rightly interpreted, agree in one. There is a deep and broad theology in the constitution of the

Firmament, which we have now contemplated, that, in harmony with the Scripture, ascribes to the Creator the perfection of wisdom, power and goodness. The atmosphere constitutes a machinery which, in all its complicated and admirable adjustments, offers the most striking displays and convincing proofs of this. This vast and wonderful appendage of our globe has been made expressly to meet the nature and wants of the living creatures and growing vegetation that occupy its surface; and all these plants and animals have been created with distinct reference to the properties of the atmosphere. Throughout *design* and *mutual adaptation* are most manifest.

The atmosphere has been composed of *those elements*, and composed of them in *just the proportions* that are essential to the health and nurture of all living creatures.

The atmosphere has been made for *lungs;* and lungs have been made for the atmosphere, being elaborately constructed for its alternate admission and expulsion. And how beautiful that adjustment by which animals breathe of the oxygen of the air, and set carbonic acid free for the use of plants, while plants absorb carbonic acid, and set oxygen free for the benefit of animals!

The atmosphere and the *ear* have also been formed one for the other. This organ is so constructed that its use depends entirely upon the elastic properties of the air.

In like manner the atmosphere and the *organs of*

speech have been formed in mutual adaptation. The whole mouth, the larynx, the tongue, the lips, have been made with inimitable skill to form air into words.

Equally evident is the mutual adaptation of the atmosphere and the organs of *smell*, as the latter can effect their function only in connection with the former.

In one word, all the parts of all animal organizations, even to the very *pores* of the skin, have been contrived with minute nicety in adaptation to the constituent elements and elastic properties of the atmosphere.

Add to all the foregoing, its admirable qualities for disseminating heat, evaporating moisture, equalizing climate, producing winds, forming clouds, and diffusing light—and we behold in the Firmament of heaven a concourse of vast contrivances, that constitute A SUBLIME ANTHEM to the Creator's praise!

"The contemplation of the atmosphere," says Whewell, "as a machine which answers all these purposes, is well suited to impress upon us the strongest conviction of the most refined, far-seeing, and far-ruling contrivance. It seems impossible to suppose that these various properties were so bestowed and so combined any otherwise than by a beneficent and intelligent Being, able and willing to diffuse organization, life, health, and enjoyment through all parts of the visible world; possessing a fertility of means which no multiplicity of objects could exhaust, and a discrimination of consequences which no complication of conditions could embarrass."—*Bridgewater Treatise*, p. 74.

The various elements composing the atmosphere, its gases, and vapors, and electricity, are, indeed, as if instinct with life and reason. Animated by the solar beams, they are everywhere in busy and unerring activity—sometimes acting singly, sometimes in combination, but always playing into each other's hands with a certainty and perfection which might almost be called intelligence, and which nothing short of Infinite Wisdom could have devised. Thus, by their manifold and beneficial operations, *The heavens declare the glory of God, and the firmament showeth his handi-work.*

"There's not a breeze
Flies o'er the meadow, not a cloud imbibes
The setting sun's effulgence; not a strain
From all the tenants of the warbling shade
Ascends, but whence the heart may find
Fresh motives to devotion."

The Third Day.

The Waters are collected, the Dry Land appears, and Vegetation is produced.

THE THIRD DAY.

GENESIS 1: 9–13.—And God said, Let the waters under the heaven be gathered together unto one place, and let the dry land appear: and it was so. And God called the dry land Earth; and the gathering together of the waters called he Seas: and God saw that it was good. And God said, Let the earth bring forth grass, the herb yielding seed, and the fruit-tree yielding fruit after his kind, whose seed is in itself, upon the earth: and it was so. And the earth brought forth grass, and herb yielding seed after his kind, and the tree yielding fruit, whose seed was in itself, after his kind. And God saw that it was good. And the evening and the morning were the third day.

WE have traced the earth through two stages of the creative process, and with the above narration we enter upon the third. A great advance was made the two preceding days; we have now a purer air, a clearer sky, and a good degree of light; but water still covers all, as at the first; one vast and shoreless ocean envelops the globe. And the first work of this day is to gather the waters together, and make a due proportion of dry land appear.

And God said, Let the waters under the heaven be gathered together unto one place, and let the dry land appear. No sooner had this command been uttered than it was obeyed; for it is immediately added, *And it was so.* In this short verse we have recorded one of the most stupendous physical events that ever occurred

on the face of our globe. No picture, no description of the occurrence is offered. We have simply set before us the mighty fact in its naked grandeur. A scene of wonders is here passed over in silence, being, perhaps, designedly left for man's future investigation and study.

The command here issued to the waters being omnific and immediately effective, must have been followed by vast and fearful convulsions of the earth's crust. The portions designed for the future continents were upheaved, while far more extensive portions were depressed, to form the hollow deeps, into which the water should flow and gather, to constitute the future oceans. In this way, we may suppose, did the dry land appear. The scene which the surface of our planet at this eventful hour presented, must have been one of supreme and terrific grandeur. We know of no language so appropriate to set forth this display of Divine power, as the words of the inspired Psalmist, "O Lord my God, thou art very great; thou art clothed with honor and majesty. Thou coveredst the earth with the deep as with a garment; the waters stood above the mountains. At thy rebuke they fled; at the voice of thy thunder they hasted away to the place thou hadst founded for them. Thou hast set a bound that they may not pass over, that they turn not again to cover the earth."

The land, as elevated from the depths of the universal ocean, was, of course, barren and bare. The

hollowed valleys, the oozy plains, and the trickling mountain sides, were alike destitute of all vegetation; no trees, no bushes, no grass, as yet, adorned the wet and slimy ground. But this condition of things was to be of short duration; on the self-same day the word went forth that stocked the earth with all sorts of trees, and shrubs, and herbs, and grasses, which were endowed with power to reproduce and spread their kind till the earth was covered, and to perpetuate their respective species to the end of time. *And the earth brought forth grass, and herb yielding seed after his kind; and the tree yielding fruit, whose seed was in itself, after his kind.*

And God saw that it was good; saw that the works of this day were all wise in their arrangements, perfect in their execution, and well-fitted for their respective ends.

The history of this day sets before us an extensive field of study. To notice all its wonderful works in detail is not practicable in this work. We must, therefore, confine ourselves to the grand results accomplished, and illustrate the wisdom, power and goodness of the Creator, as displayed in the sea, the dry land, the mountains and volcanoes, the rivers, and the vegetation of the earth.

THE SEA.

The gathering together of the waters called He Seas.

When the commotions produced by the first fiat of this day had subsided, and tranquillity in the waters had been restored, it appeared that the ancient ocean still retained his dominion over full three-fourths of the earth's surface, having yielded only one-quarter of his former empire to constitute the dry land. Thus of the 197 millions of square miles embraced in the area of the whole globe, 145 millions remained covered with water, while 52 millions comprehended the whole of the dry land.

A superficial and hasty view of this arrangement has led some to entertain the idea, that no proper or wise proportion between the extent of land and that of water was observed; and presumptuously to assert that had the Creator adopted a different division, or even reversed the present proportions, so that three-fourths should be land and one-fourth water, it would have been a better arrangement, and one more to the advantage of the human race. But these are the conclusions of ignorance. Who can undertake to tell us what all the consequences would be if any such change should take place: if, for example, the Pacific were converted into a continent, or Africa into an ocean? When man assumes to pronounce judgment in such a matter as this, he evidently adventures into depths which the scanty

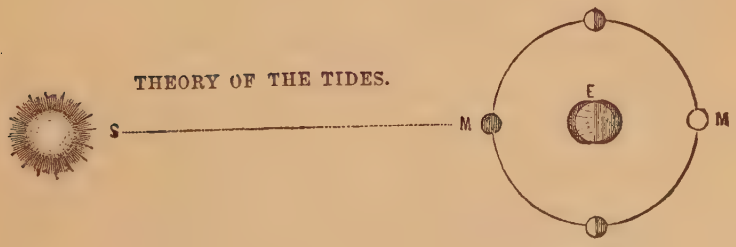
line of his reason is utterly inadequate to fathom. If the ocean were reduced to one-half its present extent, the amount of evaporation, and of rain, would be diminished in the same proportion; similar disastrous changes would take place in all the streams and rivers; the humidity and temperature of the atmosphere, together with the character of the seasons over the whole earth, would also undergo changes of a most calamitous nature. Such strictures, then, on the Divine plan savor equally of ignorance and impiety. He who weighed the mountains in scales, and measured the waters in the hollow of his hand, we may be assured, hath fixed the bounds of the sea, and determined the extent of the land, with wisdom as infallible as that which decided the ratio of the gases in the atmosphere, or adjusted the lenses of the eye for the perception of light. Laplace, after profound calculations, reached the conclusion that the quantity of water in the ocean, and its specific gravity, as compared with that of the globe, afford the most marked and beautiful instance of designing wisdom and goodness in the creation of our world.

The bottom of the sea, like the surface of the land, abounds in the inequalities of valleys, plains and hills. In those parts where its waters are tranquil, transparent, and not too deep, one may lean over the side of his boat, and see that he is gliding sometimes over meadows carpeted with green; sometimes across dales adorned with what seem like waving vines and shrubs of every form and shade; sometimes over mountain-

tops, whose sides are now gentle slopes or precipitous rocks, and now adorned with groves of living coral, branching in fantastic imitations of the shrubs and trees of the land; the whole presenting just such a view as an aeronaut would observe beneath him as he swept lowly in his balloon over a district of country. The islands are but the tops of mountains and hills that are tall enough to thrust their heads above water. The depth of the ocean, therefore, is various. Along the celebrated Telegraph Plateau, extending from Ireland to Newfoundland, the depth ranges from 10,000 to 12,000 feet. The greatest depth yet discovered is 25,000 feet, or nearly five miles; this is in the North Atlantic. The Pacific is supposed to be deeper.

An important and interesting property of the sea is its *saltness*. Although the ocean is one vast briny deep, ever agitated by wind and tide, yet it is not equally salty in all its parts. In general, its waters are impregnated with from three to four per cent. of salt. In inland seas, like the Mediterranean and the Caspian, where evaporation is very active, it is from eight to twelve per cent. On the other hand the proportion is smallest in the polar seas, where evaporation is feeble, and where great quantities of fresh water from the melting ice and snow flow in. How and when did the sea receive its saltness, are questions of interest. Some have supposed that it has derived its saline quality from the vast stores of salt laid up among the strata of the earth along its bottom; but these beds of salt found

in the earth exhibit unmistakable evidence that they themselves have been deposited from the waters of the sea. The most reasonable supposition is, that it was made salt by the Creator in the morning of time; indeed, salt seems to be an essential element in the constitution of the ocean from the beginning, as it acts an important part (as we shall soon see,) in regulating its evaporation, in producing its currents, in preserving it from corruption, and in modifying the climates even of the interior of continents. The entire amount of salt held in solution in the ocean is very great; from a safe and moderate calculation it has been estimated, that it would cover to the thickness of one mile an area of seven millions of square miles!



Among the most noticeable and important movements to which the waters of the ocean are subject, are

the *Tides*. These are regular and periodical oscillations, occasioned principally by the attraction of the moon, though the sun also has an influence in their formation; the influence of the moon being three times that of the sun. Twice every twenty-four hours the waters of the ocean rise and flow in upon the shores, and twice within the same period they retire. The tides are greatest at the new and full moon, when the attractions of the sun and moon are exerted in the same line; and least at the quadratures, when the influence of the sun goes to depress the waters at the very parts where that of the moon is exerted to raise them. Under these influences of the sun and moon, a broad wave is formed, which rushes round the globe; or rather *seems* to rush, for the water has no actual progressive motion, but simply heaves upward in succession, like the waves passing over a field of standing wheat. The height of the tidal billow varies in different places, according to the depth of the sea, and the conformation of surrounding lands. In the open ocean it seldom rises above two or three feet. In channels that open fairly to receive the flood, but whose shores contract as it advances, it mounts higher and higher. At St. Maloes it exceeds fifty feet; and in the Bay of Fundy a wave of one hundred feet high sweeps in upon the shore. The rate at which the tidal wave travels is affected by similar causes; across the southern ocean it advances at the rate of nearly a thousand miles an hour; while in the German sea its

progress is hardly fifty miles an hour. The tides are to many places of great commercial importance, giving to inland towns the advantages of a harbor. But for the tides, London would never have been what it is, the foremost commercial city in the world.—What a marvellous and beneficial arrangement have we here! The moon, an orb revolving at the distance of two hundred and forty thousand miles, so constituted as to exert a mighty and unremitting power for our good; lifting the waters of our planet in magnificent and periodical waves, to fill and empty our harbors, to wash our beaches with majestic rollers, and to maintain a regular pulse in the great ocean heart, by which its life and purity are perpetuated.

Besides the tides, there are in the ocean other established and uniform movements. Here, as in the atmosphere, solar influence is the moving power. In the exhalations that arise under this influence from the surface of the sea, not a particle of the salt it contains ascends. Hence in the intertropical regions, the great amount of evaporation which takes place leaves behind it a great amount of salt, which renders the waters saltier, and, consequently, heavier. In the polar region, on the contrary, the slowness of evaporation, together with melting snows and glaciers, contributes to keep the ocean waters fresh and light. Hence results a perpetual circulation in the sea—the salt and heavy waters of the equatorial region sink and flow along the bottom toward the poles to displace their

lighter and fresher waters, while these in consequence are forced into a contrary current along the surface toward the equator, to fill up the vacancy which the dense water leaves behind. In this way there is maintained in the great oceans of the globe a perpetual circulation from the equator to the poles, and from the poles to the equator; and thus every drop of the ocean, down to its dark unfathomed caves, is kept in constant motion and exchange.

The sea has its *Streams* as well as its general currents. Nothing can be more striking than the fact, that the oceans of our globe are traversed by *rivers* that flow as definitely and as regularly as the Danube or the Nile. Their channels are established, and for thousands of miles they pursue their course along beds and between banks of other and different water, as fixed as if built of granite rock. And if the shipwrecked mariner commits his raft to one of these, it will conduct him along its known and established route, as certainly as that the Mississippi would carry him down past New Orleans.

The most remarkable of these ocean rivers is the famous Gulf Stream, so named from the fact that it was long supposed to originate in the Gulf of Mexico; it receives its first impulse, according to Humboldt, near the southern extremity of Africa. From the Gulf of Mexico this stream flows into the Atlantic between Florida and Cuba, whence it runs northward nearly parallel to the American coast, until it reaches

Nova Scotia and Newfoundland, where it makes a great bend, and throws one branch downwards toward the Azores, while the other spreads and flows northward toward the British Islands, and thence to the Polar sea. Of this magnificent river, the banks and bottom are of cold water, and its stream is of warm water; it is seventy miles wide, three thousand feet deep, and is equal in volume to more than a thousand Mississippis. In the Gulf of Florida its speed is about eighty miles a day, but by the time it reaches the Azores it has been reduced to ten miles. Its color, as far as the coasts of the Carolinas, is that of Indigo-blue; and its banks or edges are so well defined that the mariner knows the moment his prow dips into its flood; and often, says Maury, one-half of the vessel may be perceived floating in the Gulf Stream water, while the other half is in the common water of the sea. The middle of this stream is found to be considerably higher than its edges, so that it actually constitutes a kind of serpentine ridge upon the surface of the ocean: and what is more remarkable still, it flows up-hill; in one part of its course, the gradient of its bed is not less than five or six feet in the mile. But what is most noticeable of all is its temperature and influence on climate. This is very marked. In the early history of the United States, vessels in approaching the coast in winter, were beset by snow storms and gales, that not unfrequently baffled the strength and skill of the seaman. A ship often became a mass of ice, and her

crew frosted and helpless; but if she succeeded in reaching the Gulf Stream, all was well; on approaching its edge she passed from a wintry sea into one of summer heat. The ice disappeared from the ship, and "the sailors bathed their stiffened limbs in the tepid waters of the stream." It leaves the Gulf of Mexico at a temperature of 86°, and after traversing 10° of latitude, it has lost only 2° of its heat; and after running nearly three thousand miles northward, it still preserves, *in winter*, the heat of summer. Continuing on its way, it presently "overflows its liquid banks, and spreads itself for thousands of square leagues over the cold waters around, covering the ocean with a mantle of warmth." And the genial west winds take this up, and in the most benignant manner, disperse it over all the west coast of Europe, delightfully softening and ameliorating its climate.

It is by this means and in this way that the British Islands are clothed with evergreen robes, and their inhabitants advanced to the highest development of mind and body; while in the same latitude, Labrador is bound in ice, its vegetation sparse and stinted, and its inhabitants low-typed, and not likely soon, if ever, to act any high part in the history of the race. How deeply indebted, therefore, is the favored Briton for his proud pre-eminence to this ocean stream. Divert its flow from his shores, and his glory is departed. "If a change were to take place in the configuration of the surface of the globe," says Mr. Hopkins in his address

to the British Association, "so as to admit the passage of this current directly into the Pacific, across the existing Isthmus of Panama, or along the base of the Rocky Mountains, into the North sea—a change indefinitely small in comparison to those which have heretofore taken place—our mountains, which now present to us the ever-varying beauties of successive seasons, would become the unvarying abodes of the glacier, and regions of the snow storm; the cultivation of our soil could be no longer maintained, and civilization itself must retreat before the invasion of such physical barbarism." Could anything then, be more palpable than the advantages of such a glowing stream? Or, could *benevolent design* be more conspicuously inscribed upon any work of this lower creation?

Scarcely less remarkable is another stream that flows partly in close proximity to the Gulf Stream, but in the opposite direction, and which is thus graphically described by Dr. Child: "Side by side with this warm northward-moving flood (the Gulf Stream) there is a great polar stream bearing down in an opposite direction, which appears to be more especially its compensatory current. It rises in the distant recesses of Baffin's Bay and the Greenland sea, and then, studded with icebergs, sweeps along the coast of Labrador, encircling the island of Newfoundland in its chill embrace. To the south of the Bank it encounters the Gulf Stream running northeastward;—the paths of the two giants cross each other, and they struggle for the right of

way. Their hostile waters refuse to mingle, and each continues to retain its color and its temperature. But, though neither is vanquished, each leaves its mark upon the other. From the force of the shock, the Gulf Stream, for a moment, falters in its course, and is deflected towards the south; while the Polar current, unable to break through the concentrated mass by which it is opposed, dives under the bed of the mighty stream and hastens on toward the tropics;—and by soundings, it can be recognized even among the West India Islands, with the cold label of its origin still attached to it."

Streams of a like character with those now described are found in other parts of the ocean. In the Pacific there is a stream, like that of the Gulf of Mexico, which breathes the most genial influence upon Oregon and British Columbia, giving those regions a climate in all respects very similar to that of England and Ireland. On the other side, Humbolt's Stream, proceeding from the Antarctic Ocean, conveys its cooling waters to the shores of Chili and Peru, and even as far as the Gallipagos.

Such is an outline of the Tides, Currents, and Streams, which the All-wise Creator saw necessary to establish in the ocean. Several results of a most important nature were to be accomplished through this arrangement. By this perpetual circulation of all the waters of the Deep, its purity and its life are preserved. And by means of these currents and streams from and

toward the equator, the heated waters of the tropics are conveyed to relieve the rigor of the poles; and the freezing waters of the poles are carried to refresh the regions of the tropics. By this beautiful arrangement the climate of the whole globe is equalized and improved. To all this we may add the interesting fact, that the streams which flow from the Polar Seas toward the equator carry along with them a vast amount of excellent fish from those colder latitudes; and in this way the inhabitants of the warmer regions are furnished with a supply far superior to those bred in their own heated waters. Thus these cold and warm streams are the great highways along which the inhabitants of the Deep travel from one region of the globe to another.

REFLECTIONS.

THE GREAT AND WIDE SEA! What a sublime memorial of the power that gathered together its waters! What a perpetual display of the omnipotence which confines its unstable mass within its appointed bounds! Symbol of the INFINITE! it holds us as by a spell in contemplation of its vastness and grandeur, reaching far beyond our utmost horizon, simultaneously lashing so many distant shores, and encompassing all the kingdoms of the earth. And when we view it as agitated into the violence and uproar of a tempest, and see its huge and far-reaching waves, like floating mountains, rushing, leaping for the shore, as if to scale and over-

whelm its loftiest ramparts, yet each in its turn, as if suddenly awed, subsiding and retiring at the line decreed—we feel a sacred impulse from the magnificent spectacle to fall down and worship HIM who said, "Hitherto shalt thou come, and no further; and here shall thy proud waves be stayed!"

The material globe in its outlines of land and water, and in its manifold and complicated arrangements, is *a pictorial revelation* of the conceptions, reasonings, and purposes which before lay in the Divine Mind. When the waters gathered themselves, it was not at random, but in strict conformity to his plan; and when their currents began to circulate, it was not the result of chance, but of his prescience. As He surveyed the surface of the earth at the close of the day, He beheld only what had been mapped in His own mind carried out and perfected. Hence He pronounced its arrangements all to be "very good."

In the process of the world's creation, every step taken had respect to something beyond itself, whilst the whole had reference to man, its coming occupant. In adjusting the various agencies that combine to produce the currents and streams of the ocean, the Creator was deciding the inheritance, and in no small measure also the character and history of nations yet unborn. How unsearchable are his counsels, and his ways past finding out! As He was describing the shore curves, which were to bound the Gulf of Mexico on one side of the Atlantic, He was graduating the temperature

that was to prevail in Great Britain on the other. Had the course of the stream issuing from that Gulf been directed to breathe its genial warmth on the coasts of Labrador, instead of the British Isles, how different had been the respective histories of the inhabitants of these two countries—how different, indeed, had been the history of the world! But for each, the times and bounds were before appointed. To understand the physical arrangements of our globe we must elevate ourselves to contemplate its moral ends. "The physical world," says Guyot, "has no meaning except by and for the moral world." The two are to be studied in their mutual relations and dependencies; and grand, indeed, are the harmonies subsisting between them.

He who poured into their decreed place the waters of the sea, hath power also *to dry them up again*. But will He ever do this? The scripture more than suggests the idea. "And I saw a new heaven, and a new earth; for the first heaven, and the first earth were passed away; *and there was no more sea*." This is said of our world when it shall have passed its final transformation, and been made the fitting abode of holiness. Great and marvellous are the changes through which our globe has already passed, but if we are to take these words of John, "and there was no more sea," in their literal meaning, and as setting forth one of the marked features of the renovated earth, as it appeared to him in vision, it would seem that a greater and

more wonderful change than all these yet awaits it. The earth without sea! then it must be without streams, or springs, or clouds, or rain, or dew. Then, too, the whole of its present system of vegetation, together with all its animated tenants must pass away, for the sea is the vital fountain which sustains these in being. As organized existences are now constituted, dry up the sea, and our fair, green planet would become a desolate mass of bare, brown soil and rock and sand, without a living tenant, without a flowing brook, without a motion or a sound—the stillness and silence of death would reign throughout. If, therefore, the New Earth is to be constituted without a sea, how different it must be from every thing that we now know, or can even conceive. How this globe will then be decked, how furnished, how adorned, or what will constitute the chief terrestrial delights of its happy inhabitants, we cannot tell. But this we do know, that He who is infinite in wisdom and power, can introduce new elements, effect new combinations, breathe a new atmosphere, and clothe the earth with new and etherial beauties, such as never even bloomed in Eden; and thus prepare for them that love Him, what neither eye hath seen, nor ear heard, nor ever entered into the heart of man.

THE DRY LAND.

And God said, Let the dry land appear; and it was so.

The forces employed in sinking the ocean beds and elevating the dry land, vast and uncontrollable as they appear to man, yet in the hand of Omnipotence were so directed and governed as to work out his plan at every point, in the forms, elevations and positions of all the continents and islands. Not one of these circumstances was left to chance, for not one of them was unimportant.

The OUTLINES of the various portions of the dry land are extremely various, and at first sight appear to be as much the result of accident as anything well can; yet the indentations of the coast lines were designed to have a most important bearing upon the interests of mankind, by furnishing special advantages for communication and commercial enterprise. The western coast of Europe, and the eastern coast of North America are among the most irregular and deeply indented on the globe; and it is precisely here we find science, art and refinement carried to their highest degree;—contrasting strongly in these respects with the almost unbroken shores of Africa and Australia, where the human race appears in its most degraded types. "Nothing characterizes Europe better than the variety of its indentations, of its peninsulas, of its islands. Suppose for a moment, that beautiful Italy,

and Greece with its entire Archipelago, were added to the central mass of the continent, and augmented Germany or Russia by the number of square miles they contain; this change of form would not give us another Germany, but we should have an Italy and a Greece the less. Unite with the body of Europe all its islands and peninsulas into one compact mass, and instead of this continent, so rich in various elements, you will have a New Holland with all its uniformity."*

Equally conspicuous is the presiding wisdom of the Great Architect in the ELEVATION or ALTITUDE of the dry land. Had the uplifting power been a little less, or ceased to operate a little sooner, how widely different had been the aspect of our world. A depression of a few hundred feet below their present general elevation, would cause a great part of Asia and of Europe to disappear beneath the waters of the ocean, and would reduce America to a few long islands. On the other hand, had the elevating force been greater, or longer in operation, so as to lift these entire continents a few thousand feet higher, both the climate and the vegetation of the whole globe would have been very unlike those that now prevail; Europe would have been left without a vineyard or a fruit-tree; and the warm and fertile plains of India, now adorned with all the rich productions of a tropical climate, would have been as the cold desert Plateaus of Thibet. Or, let us suppose that the elevating power had raised the south-

* Guyot's Earth and Man, p. 26.

ern region of North America only a little higher, so as to produce a gentle declivity of the general surface toward the north, and thus caused the waters of the Mississippi and of all its numerous tributaries to flow and discharge into the Frozen Ocean;—what vast and inestimable advantages had been lost to this continent! Or, once more, suppose the long and lofty range of the Andes had been elevated along the *eastern* coast of South America; this also had been followed by disastrous results, for it would have hindered the trade winds from bearing the vapors of the ocean into the interior of the continent, and the plains of the Amazon and Paraguay, in consequence, would have been but deserts. From these and a multitude of similar facts, it is evident that the various Table-lands and mountain chains, which cover the surface of our globe, have been arranged after a predetermined plan into a regular and complete system of slopes and counterslopes—a system, the issues of which must have all been plainly foreseen by Him who bade the dry land appear.

Look again at the RELATIVE POSITIONS of the different parts of the dry land. To this some of the fairest spots of the earth owe their chief advantages. "Do not the three Peninsulas of the south of Europe owe to their position their mild and soft climate, their lovely landscapes, their numerous relations, and their common life? Is it not to their situation that the two great peninsulas of India are indebted for their rich nature, and the conspicuous part one of them, at least, has

played in all ages? Place them on the north of their continents, Italy and Greece become Scandinavia, and India a Kamtschatka. All Europe is indebted for its temperate atmosphere to its position relatively to the great marine and atmospheric currents, and to the vicinity of the burning regions of Africa. Place it at the east of Asia, it will be only a frozen peninsula."*

Again: If on the morning of the third day the vast regions of the poles had been elevated into dry land, instead of being left beneath the ocean as we now find them, we have reason to believe that our globe long since would have become uninhabitable. For in that case, by the process of evaporation and the agency of the aerial currents, the whole ocean would have been transferred from the tropics to the poles, leaving the former dry, and piling the latter with mountainous accumulations of ice and snow. But with the existing arrangement such appalling results are effectually and happily avoided. The polar snows fall upon those seas, or upon their frozen surfaces, and form floating masses of ice, which are partly broken up and drifted away in the form of icebergs, and partly melted where they are by currents of water perpetually streaming in against and beneath them from warmer regions, and thus become restored to the general ocean.

These, and many other similar facts, demonstrate to us that *infinite wisdom*, as well as unlimited power, were concerned in the elevation of the dry land. The forms,

* Earth and Man, p. 27.

the height, and the position of its several masses, irregular and accidental as they may appear, reveal a plan that had distinct and direct reference to the future history of the world. In tracing the coast lines, and in describing the surface elevations of the different portions of the land, the Creator decided in no feeble degree what the occupation and character of their future population would be;—whether keepers of flocks and herds, or doers of business in great waters, or exhumers of "the chief things of the ancient mountains." Each quarter of the globe, each continent, doubtless, was made and meant to develop its appropriate phase of human character, while the whole was to form the grand theatre whereon the ETERNAL LOGOS was to work out his wondrous and far-reaching scheme of mercy and salvation to a race that would become sinners and self-ruined.

The surface of the land part of the globe we find coated over, to a greater or less depth, with *a covering of soil.* This consists of pulverized rocks, mingled with calcareous substances, and the decomposed remains of animal and vegetable organizations. This soil is less or more productive according to its depth, and according to the proportions in which these substances are mixed in it. This vegetative covering, with comparatively limited exceptions, is spread over the surface of all the dry land, from the summits of the mountains down their gentle declivities, and over all the plains below. By whatever agencies this important envelope was

formed, and thus spread out, we behold in it the arrangement of a wise and benevolent Mind, making a most ample provision for a vegetation suitable for the support of man and every living thing. No candid mind, who duly considers the nature of the substances composing the mass of the earth's crust, can resist the conclusion that the clothing of its surface with productive soil is as much an evidence of wise and benevolent intention, as is the enclosing of an animal body in a skin covered with hair.

Descending from the carpeted floor of our terrestrial habitation into the vaults of its lower story, we find them filled with the provisions of God's love for man. Its strata, like so many shelves, to unknown depths, are crowded with stores of all manner of useful things for his service. Here is a magazine of minerals and metals proffering him the means of multiplying his conveniences, extending his civilization, and advancing his own knowledge, refinement, and happiness. Here are beds of *granite* to supply him with building materials that will defy the force of time and tide; *marble* of every grain and shade of color for his temples, palaces, or statuary; *limestone* to improve his soil and cement his walls; *slate* to cover his roofs or lay his floors; *gypsum*, white as snow, to finish and adorn his apartments; the hardened *grit* to grind his corn; *sand* to make him glass; and *clay* to fabricate his wares; *chalk*, *basalt*, *porphyry*, *sandstone*, and a multitude of other minerals, all convertible by in-

genuity and industry into various useful and important ends. In the great cellars below we also find laid up ready to his hand an abundant stock of *coal*, wherewith he may warm himself, and multiply the strength of his arms a million fold. In close connection with this are *fountains of oil* to supply his lamps. And here too are inexhaustible stores of *salt*, an article of prime importance to him and to the living creatures around him.

Among the strata of the rocks, in their joints and fissures, and interlacing their solid masses, are also provided and laid up for man, METALS of different qualities, and adapted to all the various purposes of life. Here are to be found the precious and beautiful metals of *gold* and *silver* to serve him for coins, medals, and ornaments; *mercury*, *antimony*, *arsenic*, *potassium*, *phosphorus*, *aluminium*, *sulphur*, *sodium*, *magnesium*, to supply him with chemicals for his arts, and medicines for his health; *tin*, *copper*, *nickel*, *zinc*, *plumbago*, *platinum*, *cobalt*, *lead*, etc., to construct him instruments, utensils, and other conveniences without number. Above all, here are inexhaustible stores of *iron*, the most useful, and, therefore, the most valuable of all the metals. The uses of iron to man are not to be numbered or estimated. It ministers to his necessities and comfort, to his ease and safety, from the beginning of his life to its close; it is equally serviceable to the arts, to agriculture, to navigation, and to war; out of it are made the sword and the ploughshare, the scissors

and the needle, the cable and the anchor, and ten thousand other instrumentalities in daily use on sea and land.

Treasured up in her subterranean coffers, the earth also holds in keeping for man a great variety of PRECIOUS GEMS—the hard and glittering *diamond*, the brilliant *emerald*, the pink and yellow *topaz*, the azure *sapphire*, the purple *jacinth* and *amethyst*, the beautiful *beryl*, the variegated *agate*, the girdled *onyx*, the *opal* of rainbow hues, the transparent *crystal*, the white and red *cornelian*, together with many others of rare beauty and great value. These gems of the earth, formed and colored by God's own hand, were made for man *exclusively*, for of all creatures on this earth he alone is endowed with faculties to appreciate and with taste to enjoy them. And they serve to remind us that our Father in heaven stopped not short in his regard for us at the point where our bare wants were supplied, but was pleased to add the charms of beauty, over and above, in order to gratify his children.

But let us look more closely at the mass of materials composing the crust of our globe. If we carefully inspect and study the structure and constitution of its minerals and metals, we shall discover other striking displays of the matchless skill and perfect agency employed in the formation of our earthly habitation. Every one of the minerals composing its substance has its own peculiar formation, physical

CRYSTAL FORMS.

character, and chemical properties; and when we come to understand these, we shall no longer regard them as mere shapeless masses, or simply as having here a pretty form, and there a beautiful tint; but as objects modeled by the Divine Hand, and revealing the Divine Mind. We shall discover that even in the profound depths and dark recesses of the earth, where the influences necessary to sustain organization and life cease to act, the creative Spirit has pursued his stupendous task of giving form and beauty to every particle of matter.

Nearly all the minerals of the globe are found to be made up of minute crystals, closely packed and firmly held together. These crystals are of great variety, differing not only in size, but in their angles, facets, and general configuration, in different substances. But the crystal form in any one particular mineral is the same everywhere; that of quartz, for example, whether taken from the Alps, the Andes, or the Himalayas, is the same, not an angle is found to differ. So of iron, salt, marble, etc. Hence each mineral may be properly said to have as much a distinct shape of its own as each plant or animal, and may be as readily distinguished by the character presented to the eye. Crystals are distinct and perfect individuals in the mineral kingdom.

The uninformed may regard beds of rock, or masses of ore, as chance agglomerations of matter; but these combinations and figures of crystallization are so far

from indicating the fortuitous result of accident, that they are disposed according to laws the most severely rigid, and in proportions mathematically exact. So minutely and elaborately wrought are the geometrical patterns of crystals, that they are found to reappear after the most minute subdivision. Beneath the fixed variety of external or secondary forms which crystalline bodies assume, there is an ultimate or primitive form retained by the smallest particles of each crystal. "Every crystal of carbonate of lime," says Buckland, "is made up of millions of particles of the same compound substances, having one invariable primary form, viz., that of a rhomboidal solid, which may be obtained to an indefinite extent by mechanical division."

In the works of crystallization we behold the perfect figures of geometry, as traced by the finger of God. "To the uninstructed eye," says Dana, "these cubes and prisms of nature, with their numberless brilliant surfaces, often appear as if they had been cut and polished by the lapidary; yet the skill and finish of the work—most perfect in microscopic crystals—have but feeble imitation in art. Not unfrequently, crystals are found with one or two hundred distinct planes, and occasionally even a much larger number; and every edge and angle has the utmost perfection, and the surfaces and evenness of polish that betrays no rude workmanship, even under the highest magnifying glass. Cavities are occasionally met with in rocks, studded on every side with crys-

tals—crystal grottos in miniature—sparkling, when brought out to the sun, like a casket of jewels. Even amid the apparent confusion, there is wonderful order of arrangement in the crystals; the corresponding planes generally face the same way, so that the sparkling effect appears in successive flashes over the surface, as every new set of facets comes in turn to the light. Add to this view their delicate colors—the rich purple of the amethyst, the soft yellow shades of the topaz, the deep green of the emerald—and it will be admitted that the powers of crystallization scarcely yield to vitality in the forms of beauty they produce."

The marvellous excellency of the Creator's workmanship in the formation of the earth also appears in *the diversity of productions fashioned out of the same elements.* While the appearance and distinguishing characteristics of marble, slate, porphyry, limestone, and basalt, are as distinct as can well be imagined, the real ultimate difference in their composition is extremely small. Few things are more unlike than common clay and the precious rubies, sapphires, beryls, garnets, and carbuncles, yet all these are but so many modifications of *clay.* Of all gems the diamond is the hardest, the most beautiful, and the most valued; yet, strange to say, it is but a lump of charcoal in a crystallized form, and, like charcoal, can be made to burn, and its whole substance to disappear in carbonic acid gas. And thus it is throughout nature.

From a few simple substances the Divine Artificer has produced a multitude of useful minerals and beautiful gems, all differing so widely that, from their appearance, we should never think of comparing them with their original elements, or even suspect that any relation subsisted between them.

REFLECTIONS.

The earth is the Lord's; but he hath filled it with his riches for the children of men. And who can review its varied and invaluable treasures, and not see in them the intentions of his wisdom and the benevolence of his heart toward his earthly offspring! Of those enumerated in the foregoing pages, three especially demand our devout and grateful reflections:

Salt.—This is an article of prime and universal necessity, being an element essential to healthy nourishment. And the beneficence of the Creator is clearly seen in its universal distribution. Not only is it obtainable from the briny waters of the ocean along all the coasts, but saline springs, and solid beds of it in the form of rock, are dispersed generally over the continents and large islands; so that this source of health and daily enjoyment is within the reach of the inhabitants of every region of the globe.

Coal.—This is the most valuable fuel in existence. The help and enjoyment man derives from it cannot be calculated. It warms the homes and prepares the food of millions. It enlightens the streets and habita-

FOREST OF THE COAL PERIOD.

tions of unnumbered cities. It aids in the manufacture of a thousand things of use and of beauty, at the forge and in the furnace. It generates the steam that weaves our cloth, grinds our corn, prints our books, draws our trains, and impels our fleets. In a word, it lends to man a power that never wearies, a power that may be directed to any purpose, and a power that scarcely knows a limit. If the mechanics of the United States annually consume ten millions of tons of coal to run their various machineries, it gives them for their work the aid of a force equal to that of an army of men numbering twice the whole population of the country. Of this most useful mineral God has laid up a bounteous store for us. The area of the coal fields of the world, so far as discovered, is estimated at two hundred and twenty thousand square miles; and these fields, by the beneficent design of the Creator, have been widely distributed over the globe.

And now let us devote a moment to contemplate the origin and history of this most valuable production. Far back in the pre-Adamite periods of our planet's history, when its climate was much warmer and more humid than at present, nature, at her Lord's bidding, roused to put forth her chief energies in the production of vegetation. Hence the earth everywhere became shaded with dark and tangled forests of strange and stupendous growths. "Wherever dry land, or shallow lake, or running stream appeared, from where Melville's Island now spreads out its icy wastes under

the star of the pole, to where the arid plains of Australia lie solitary beneath the bright cross of the south, a rank and luxuriant herbage covered every foot-breadth of the dank and steaming soil."* Whole regions of these dense forests and abounding growths were from time to time submerged; while in other parts torrents of rain and sweeping floods, such as are now unknown, carried them, root and branch, into the neighboring bays. Thus the stupendous vegetation was accumulated age after age at the bottom of the sea, and there the Hand Unseen carried them through chemical changes, by bituminous springs and other agencies, and compressed them by the weight of after deposits into solid layers, till, in the lapse of time, they were converted into what now constitute our coal-fields. And what is equally interesting and instructive, the proof that this was actually the origin of coal is still visible and open to our inspection. Speaking of the coal mines of Bohemia, Dr. Buckland tells us, that "the most elaborate imitations of living foliage bear no comparison with the beautiful profusion of extinct vegetable forms with which the galleries of these coal mines are overhung. The roof is covered as with a canopy of gorgeous tapestry, enriched with festoons of most graceful foliage, flung in wild and irregular profusion over every portion of its surface. The spectator feels himself transported, as if by enchantment, into the forests of another world; he be-

* Testimony of Rocks, p. 160.

FOSSIL VEGETATION FOUND IN COAL.

holds trees and forms and characters now unknown upon the surface of the earth, presented to his senses almost in the vigor of their primeval life—their scaly stems and bending branches, with their delicate apparatus of foliage, are all spread forth before him, little impaired by the lapse of countless ages, and bearing faithful records of extinct systems of vegetation which began and terminated in times of which these relics are the infallible historians." However remote the period at which this rank and luxuriant vegetation flourished, and whatever incidental or temporary purposes it might have served at the time, the Great Builder of the world had a future and prospective end, both in its production and in its marvellous preservation. For, like a house in process of erection, every change wrought in its substance, and every new production introduced upon its surface, were so many steps in the earth's progressive preparation for an occupant that was yet to be created. That coal was manufactured and stowed away in the mighty cellars of the earth till he should come. He has come. And now, after the lapse of unrecorded ages—now at the end of time—the earth yields up these her long-held stores, and the extraordinary productions of the most extraordinary period of its history, are made to minister to the comfort, improvement, and elevation of the last-born of creation—man. How interesting to think and to be thus assured that, long before we came into being, our Father was already caring for us, and stor-

ing the earth with such things as he knew we should need.

Iron.—Few objects in creation bear more conspicuously the impress of *beneficent design* toward man than this. The *existence* of such a metal as iron is proof of this. Had silver and gold not been created, or were they to-day annihilated, the world would go on just as well. But what would be our condition without iron? What would supply its place? Nothing in all the realm of minerals. Without iron, from the very pinnacle of our civilization, we should go down quickly into barbarism, unless saved by the special interposition of Heaven. Without iron, the earth would have been unfit for man and man unfit for the earth. The *abundance* provided of this metal is another evidence of God's prospective care for man; what He foresaw to be most needful He prepared most plentifully; iron ore is distributed very widely over the earth. The *malleability* of iron bears a similar testimony; had it been as unyielding as flint, or brittle as antimony, it would have been comparatively worthless. Its *hardness* and its *susceptibility of being hardened* to any required degree, are also qualities that plainly attest a foresight of the wants of coming man and a care to meet them. The *strength* of iron and its *capacity for welding* evince the same. Its *wholesomeness* is another important quality; to reduce iron from its native state to the purposes of usefulness requires long labor over it, and if it had been poisonous, as many of the metals

are, man would perish in his attempts to avail himself of its advantages. The *native location* of iron likewise indicates benevolence of design in reference to man; the ore being generally found in the immediate neighborhood of coal to melt it, and of lime to facilitate the process. Now, who that duly considers the foregoing properties of iron, but must be struck with admiration at the combination of excellent qualities that meet in it, and be fully convinced that it was made and meant for the service of man!

God saw the end from the beginning. Out of the remotest depths of the past, and all along as the world was forming under his plastic hand, He looked forward to man, who was to be the heir and head of this lower creation. The wants, the progress, and the destiny of our race were held steadily in view, as it passed through all its wondrous changes; so that it may be said, and truly, that the stupendous miracles of bygone creations were conducted with a reference to our present comfort and improvement. From the bowels of the earth, then, and from the wreck of former worlds, we may derive materials with which to erect an altar of gratitude to HIM who treasured up for us "the blessings of the deep that lieth underneath," and "the precious things of the everlasting hills."

MOUNTAINS.

By his strength He setteth fast the mountains, being girded with power.

Of the varied features of the Dry Land, mountains are the most conspicuous; their height, their masses, their bold outlines and varied scenery, render them the most attractive and the sublimest objects presented on the face of the globe. Like the currents in the atmosphere and the streams in the ocean, they constitute important agencies in the economy of the world, by which the Creator bestows many blessings upon its inhabitants.

Mountain chains of greater or less altitude and extent traverse every quarter of the earth. In Europe we have the range formed by the Pyrenees, the Alps and the mountains of Dalmatia, whose highest peak, Mount Blanc, is 16,000 feet above the level of the sea. In Asia we find the Uralian, Caucasian, and Altai chains; but the grandest range on this continent, and the highest on the globe, are the gigantic Himalayas, which culminate in Mount Everest, which is 29,000 feet high, and visible at the distance of 230 miles. In Africa we meet with the Greater and Lesser Atlas, of classic memories, reaching an elevation of some 12,000 feet. In the New World, the Rocky Mountains and the Andes constitute one grand system, running from north to south, along the whole western edge of North

and South America, a distance of over 8000 miles; of this chain the highest point in South America is Nevado de Sorata, being 25,300 feet; and the highest in North America is St. Elias peak, whose altitude is 17,800 feet. Such are the grand and principal ranges of the world.

These lofty mountain chains were not created in the beginning *where* and *what* we now behold them; but have been subsequently formed by the elevation of the solid and rocky crust of the earth, thrust up by stupendous forces from beneath. Three things go to prove this fact:—1. Geological observation proves to us as plainly as that a heap of oak chips must have once belonged to an oak tree, that the rocks which compose the loftiest mountains belong to formations whose natural and original positions are hundreds, and even thousands of feet below the present general surface of the earth. 2. The mountains still bear upon their own brows the evidence of their upheaval. If masses of rocks hundreds of miles in extent were raised to the elevation of mountains, they would naturally at different points break, and crack, and open into chasms by their own enormous weight; and this we find has actually been the case. The whole Alpine region exhibits such fractures; at an elevation of some 4,000 feet we meet a chasm 100 feet wide, and descending to dark and unknown depths, all the prominences on one side exactly corresponding to the indentations on the other. In the Pyrenees are found four enormous

chasms, almost perpendicular, which divide both mountains and their valleys, and which appear as if they had but just been rent asunder. The ranges of the Andes throughout present similar disruptions, indicating plainly the operation of the tremendous power to which they owe their present elevation. 3. The remains of marine animals, found in such variety and profusion far up these mountains, prove incontestably that they once existed beneath the ocean waters. On Mount La Bolca alone, not less than a hundred different species of fossil fishes have been found. And Humboldt discovered sea shells on the Andes at an elevation of more than 14,000 feet.—From all the foregoing facts, it is evident, that the mountains are elevations of the earth's crust, effected long after its original creation.

The diversity of surface which the Dry Land presents in its mountains, plains and valleys, clearly exhibits the arrangements of the same beneficent wisdom, as we have seen in the atmosphere and in the ocean. Yet some there have been, so devoid of both taste and wisdom, as to pronounce the rocks, precipices and mountains of the globe, as so many rude and unsightly excrescences on the face of nature; and to hold that a smooth and level surface would have been far more to the advantage of man, as in that case travelling, agricultural operations, etc., would have been much facilitated. Such ideas can proceed only from ignorance. Very many and most important are the bene-

fits derived to the world from the mountains and hills which so generally and so beautifully vary its surface.

Mountains exert a most important influence upon *climate*, by affecting the currents of the atmosphere, mitigating the cold, intercepting the clouds, and shielding extensive districts from the unbroken violence of the storms, and northern blasts. They have been built up by the Great Architect, in selected situations and for specific ends—to direct the course of the winds whither he would have them blow, and to draw from the clouds their enriching moisture where they are needed. Mountain chains are, in fact, to be reckoned with the streams of the ocean, and the currents of the atmosphere of the number of the great agencies which He has arranged and combined to equalize the general temperature of the earth; nor is it possible to calculate all the evils and disadvantages that would result from reducing them to its general level.

To these lofty elevations the globe owes its magnificent system of *Rivers*. Mountains are the great condensers of the atmosphere, and the sources of springs, rills, brooks and rivers. They receive, in the form of rain or snow, the vapors with which the atmosphere is charged, even when the plains below may be parched with drought. And hence the irregular and mountainous surface of the earth is veined over with the channels of flowing water to supply the wants of all living creatures. If the earth had no mountains, and had been a uniform level, it would have been comparatively

a *marsh;* rains would have gathered in stagnant pools, and sent forth noxious exhalations, pregnant with disease and death.

Had the earth been formed a smooth and perfect globe, it would have been destitute of many of the *plants* and animals it now possesses, whose appropriate place and habitation are the mountains. "The high hills are a refuge for the goats, and the rocks for the conies." And on these elevations also grow many plants which cannot be successfully cultivated on the plains. In the forests which adorn the mountains' brow, and on the bare rocks of their summits, unshielded from the chilling air, grow some of the rarest and most useful plants, botanical curiosities, and roots of medicinal virtue.

But for the upheaval of the earth's crust into these mountain elevations, we should be, to the end of time, without most of those minerals so valuable and essential to man. If the surface of the ground had been level, and the several strata which compose it lay evenly and regularly, one below the other, like the coats of an onion, the upper stratum only would have been accessible to man. The various intermixture of limestone, granite, sandstone, clay, etc., which are now so advantageous to the fertility, and beauty, and habitability of the globe, in that case, would have no place. The inestimable treasures of salt, coal, iron, copper, etc., belonging, as they do, for the most part, to the older and deeper formations, would have been forever beyond the

reach of man. This the Divine Builder foresaw, and in equal wisdom and goodness employed his mighty powers to thrust up these layers into mountain heights, thus breaking them, and exposing their edges, with all their valuable contents, to the hand of man.

Through the instrumentality of mountains man is also helped in what he cannot help himself in another way; their lofty summits, in many regions, serve as inexhaustible reservoirs of water, which they hold in the form of ice and snow, till summer advances, when they gradually melt, and flow down in grateful supplies to the panting plains below. In this way the snows and glaciers of the Himalayas feed the Ganges, the Indus, and the Burhampootra; and those of the Andes the streams which water Peru and Chili. The supplies of water thus secured from the mountain tops during the summer months is invaluable to some of the finest countries of the globe.

Had our world been formed without mountains or hills, it would have been destitute of the grandest scenes that now adorn it. Deprived of these magnificent and charming elevations, the face of nature would present an unvaried scene of dull uniformity, as fatiguing to the eye as the solitudes of Arabia, and as uninteresting to the mind as the monotony of the ocean. To its hills, and valleys, and mountain ranges, the earth owes its chief scenic grandeur—its sweet variety, its softer loveliness, and its rugged magnificence, which now make it so glorious a mirror of Power, and Wisdom, and Goodness.

As an example of the scenic grandeur of the mountains which adorn our globe, I set before the reader the majestic Ararat, of 17,750 feet height, as described by an eye-witness, Sir Robert K. Porter:—"As the vale opened beneath us, in our descent, my whole attention became absorbed in the view before me—a vast plain, peopled with countless villages; the towers and spires of Eitchmai-adzen arising from amidst them; the glittering waters of Araxes flowing through the green, fresh vale; and the subordinate range of mountains skirting the base of the awful monument of the antediluvian world, it seemed to stand a stupendous link in the history of man, uniting the two races of men before and after the flood. But it was not until we had arrived on the flat plain, that I beheld Ararat in all its amplitude and grandeur. From the spot on which I stood, it appeared as if the hugest mountains of the world had been piled upon each other to form this one sublime immensity of earth, and rock, and snow! The icy peaks of its double head rose majestically into the clear and cloudless heaven; the sun blazed bright upon them, and the reflection sent forth a dazzling radiance equal to other suns. My eye, not able to rest for any length of time on the blending glories of its summits, wandered down the apparently interminable sides, till I could no longer trace their vast lines in the mists of the horizon; when an inexpressible impulse, immediately carrying me upwards, again refixed my gaze on the awful glare of Ararat; and this bewildered sensibility of sight being

answered by a similar feeling in the mind, for some moments I was lost in a strange suspension of the powers of thought." What an object of surpassing grandeur is here set before us! What a majestic and glorious monument to the praise of HIM whose mighty power thrust upwards its stupendous mass from the depths of the sea, to be a rescuing place to the second father of mankind, and to be the memorial and admiration of his multiplied posterity through all succeeding time!

REFLECTIONS.

As the builder decides by *Rule* the proportions of every column and the dimensions of every arch that enters into the noble structure that is rearing under his hand—so the Divine Architect in the erection of this earthly temple, "weighed its mountains in scales and its hills in a balance;" their positions He determined by unerring calculation, and their forms He carved out with his own right hand. Over the stupendous agencies employed in lifting them from their depths to their present elevations, He presided with unremitting attention, so that at every point, forces of a right intensity and right direction were made to co-operate, so as to work out infallibly every result and arrangement embraced in his eternal plan. Wild and convulsive as those forces appear to have been, all were directed by the most far-reaching foresight to purposes of human improvement and happiness. Gases, steam, earthquakes, volcanos—these were the

tools wielded by the Divine Hand in the construction of man's world. Far from being lawless elements, or interferences with the terrene architecture, they were the very means by which it was built up into special order, at once most beautiful and most appropriate for him. And the praise of the great Master Builder now ascends from the frowning precipice and the snow-capped heights of the mountain, as well as from the luxuriance of the plains and the smiles of the valleys.

When the Creator was forming the earth, and "His hand preparing the dry land," to be a habitation for man, He designed and constituted it to minister to him something more than the mere elements of bodily sustenance. Its arrangements had reference to his mental as well as corporeal wants. Its substance was so moulded, its outlines so drawn, and its scenes so painted as to have an important bearing upon his intellectual and moral character. The mountains and the hills were to be to him as *schools;* and what magnificent educational institutions are they in these latter days found to be. Their mighty masses and far-reaching agencies—what are they but visible displays of the stupendous power and contriving skill of the INFINITE. And their rocks—what are these but libraries abounding in treasures of wisdom and knowledge, their every stratum being a volume written within and without, recording the deeds of OMNIPOTENCE in periods that long antedated the birth of our race. And the ever-varying scenery with which the earth is over-

spread, doubtless, was also designed for man's instruction—designed to delight, or rouse, or refine his soul, and to aid in forming his character and deciding his history. The extended plain, the naked cliff, the distant forest, the deep and silent glen, the slow-flowing and meandering river, the rugged mountain, the bold headland, the thundering cataract—all were to be means of quickening the human mind into obedience to the Divine Will, or of soothing and inspiring the human heart for communion with the Divine Spirit.

It was ordained, as history has revealed, that mountains should be associated with the most signal and important moral dispensations of Heaven toward our race. Those of the land of miracles stand before us as if sculptured and painted with sacred legend. Each, by the imperishable memory of the judgment, or the revelation, or the mercy with which it stands connected, reads to us a lesson of deep and solemn import. The majestic *Ararat*, lifting high its glittering summits, proclaims to the world in terms and tones that cannot be misunderstood, the inevitable vengeance that will finally overtake the impenitent and incorrigible. *Moriah*, with its altar and human victim, holds forth to our view the glorious triumph of implicit faith in God. Granitic *Sinai*, from amid clouds and thunderings, bids us hear and obey the Law of the Lord our God; while *Horeb*, at its side, with its flinty rock and flowing stream, invites and woos us to its Antitype Divine, the Rock Christ Jesus, from whom flows the waters of life.

Hor and *Pisgah*, in softened sadness, speak and prove to us from the graves of the chosen leaders of the sacramental hosts of God, that however useful or eminent, or honored our position may be, we, too, shall soon be called to render an account of our stewardship, and to lie down in the silence of the grave. The "excellency of *Carmel*" holds forth its signal and miraculous demonstration of the certain destruction of error and idolatry, and the ultimate triumph of truth and righteousness over every enemy. Encompassed with scenery of surpassing beauty, *Tabor* invites us to ascend its sacred height, and in meditation review the glorious scene of the transfiguration of the Son of Man, as in converse with Moses and Elias, saints returned from glory. And *Olivet*—mount of sacred and endearing memories—with soft and plaintive echoes is repeating in our ears, *yea within our hearts*, the wondrous words of agonizing love! and bids us advance and view the spot from whence our triumphant holy Lord ascended far above all principality and power, and might, and dominion to the right hand of the Father Almighty.

So has Divine Providence ordered events that these mountains have become enduring monuments, standing up in their might and grandeur, as witnesses for God, and for the Book of his truth, throughout all generations. No authority of persecutors can silence the voice they utter; no efforts of infidels can efface the record graven upon their brows; no edict of kings or potentates can extinguish the sacred associations with

which their names will forever come up in the mind of man. So indelibly have the visitations of Heaven been stamped on the face of the earth.

RIVERS.

He cutteth out rivers among the rocks.

Water is the vital fluid of the globe; and the ocean the clouds, the rain, and the rivers are the four great organs by which its circulation is ceaselessly carried on. From the ocean water ascends in the form of vapors; these vapors, in the higher regions of the firmament, are collected into clouds, and carried by the winds over plain and mountain tops; and the mountains, acting as loadstones, draw from the clouds their treasures in showers—their wet and misty summits are untiringly occupied with this important work; and from these summits, on every side, the rains flow down in numerous rills, these coalesce into larger streams, and these streams again unite to form the great rivers, which roll their waters back into the ocean; thence, in due time, to pass through the same round again. Of this great physical fact no words can be a more correct and beautiful expression than those of scripture, "Unto the place from whence the rivers come, thither they return again."

The number of rivers on the globe is very great; it has been reckoned that there are, both in the Old and

New World, nearly seven hundred principal streams, that discharge directly into the ocean. These, together with their innumerable tributaries, constitute a grand *System of Drainage*, with which the beneficent wisdom of the Creator has furrowed the face of the earth.

In Europe, the Rhone, in its wanderings of four hundred and forty miles, drains the waters of an area of 7,000 square miles. The Rhine, which has a length of seven hundred miles, carries to the sea the waters of a region of twice that extent. The Danube pursues a course of 1,800 miles, and draws its waters from an expanse of no less than 55,000 square miles. And the Volga, in its slow and turbid windings of 2,100 miles, gathers the waters of nearly one-half the great empire of Russia.

Asia is traversed by a more magnificent system still. In China we have two rivers, each over 3,000 miles long; and in Siberia, two others that rival them in dimensions. The Irrawaddi and the Maykaung, in Siam, are both rivers of royal magnitude. In western Asia, are the Euphrates and Tigris, of ancient memory. And British India has principal rivers, whose united length exceeds 10,000 miles; of which the most celebrated is the Ganges, which, after leaping into sight for the first time from a perpendicular wall of ice in the Himalayas, and pursuing a course of nearly 1,900 miles, draws its sacred waters from a district of unequalled fertility, embracing an area of not less than 400,000 square miles.

Africa has but comparatively few rivers. The Niger stretches its crooked length over 2,000 miles. The Nile, proceeding from its long-veiled sources, after wandering through 2,400 miles, flows through its remaining eight hundred miles, without receiving a single tributary.

But it is in America that we find rivers attain their full magnitude and grandeur. The St. Lawrence draws the waters of 300,000 square miles; the Mississippi, of nearly 4,000 miles length, from a surface of 1,000,000 square miles; and the Amazon the waters of a region three times as large as that of all the rivers of Europe that empty themselves into the Atlantic, and presenting, near its mouth, a stream of the gigantic dimensions of one hundred miles width and six hundred feet depth.—In the rivers, then, we have a system of drainage and irrigation, of extent and grandeur commensurate with the amplitude of our globe, and worthy of Him, who, in the beginning, scooped out their channels, and taught them all their devious ways to the deep.

The benefits derived to the world from its network of rivers are obviously incalculable. Besides draining the earth of its surplus waters, without which some of the fairest portions of its surface would soon be submerged, and become forever uninhabitable by man—they are the means by which all living creatures on the dry land are furnished with their needed drink, and man with a most valuable supply of food in the fishes they breed. They also open noble channels of

commerce with distant and interior countries; while, in their course to the sea, they offer unlimited power and facilities for manufacture. The value and importance of this great arrangement of our globe are strikingly evidenced by the fact that rivers have built, and have furnished the wealth of, the most renowned cities of the earth. The richest monuments of art and industry which the world possesses are reflected in their waters. Thebes and Memphis owed their splendor to the Nile; and Babylon its birth and greatness to the Euphrates. The Orontes furnished the site of Antioch; and the Tiber founded and erected Rome. The Thames has given to England its London; and our own noble rivers have built us all the richest and busiest cities of the land.

The rivers greatly add to the beauty of our world. Many of its most picturesque sceneries—its mountain gorges, its wild glens and ravines, its rushing rapids and roaring cataracts, which entrance the beholder—are due to the action and flow of streams. And what can be more interesting to the mind, or more delightful to the eye, than to behold the river at length emerging from the mountain's confined and contorted channel into the green and open plain, with banks lined with stately trees, widening and winding through its fertile meadows; now mirroring the beauties of town and villas, and now calmly sweeping through the populous city, and bearing on its placid bosom the ships and flags of different nations! Nowhere does our world

array itself in sweeter or more pleasing features than along its river banks. Here are the earth's most delightful spots. A river, we find, was essential to complete the beauties and delights of Eden; and it is with the flow of the "River of the waters of Life" that the Beloved Disciple gives the finishing touch to his sublime description of the Paradise above.

REFLECTIONS.

In the Rivers, as in the Mountains, we behold goodness, ever-flowing goodness. The heathen Greeks, in order to represent the universal power and beneficence of Jupiter, used the symbol of a river flowing from his throne. Substituting the Living God for that imaginary deity, there will be truth and deep significance in the symbol. Ever since the morning of creation, the rivers have been the appointed ministers of his bounty; fertilizing, beautifying and blessing everywhere this abode of man. And while the mountains lift their towering summits to the glory of his mighty power, the rivers, all their journey through, sweetly murmur praises to the riches of his goodness.

Rivers, like mountains, also, have their sacred associations. Their meanderings are the handwriting of Heaven in the soil of the earth, recording its own great transactions. The Euphrates, while it flows, will speak to man of the garden of innocence. Arnon and Jabbok, Kishion and Kedron, will never cease to relate to the passing traveller their ancient memorials. And the

river of Egypt—to a hundred generations already passed has this spoken of Jacob's favorite son, of God's oppressed people, and of their hidden deliverer among the reeds; and to all the generations yet to come will it tell the same. Its mighty cities have perished, its kings have been forgotten, and even its stupendous pyramids are crumbling away; but while the periodic waters of the Nile continue to rise and fall, they will continue to ripple in the ears of men the undying story of Joseph, and of the brickmakers, and of the infant Moses rescued from its banks. And as for that sacred stream, the Jordan, its very name is pregnant with a thousand memories of wonders and of love. Its source, its lakes, its shores, its quiet pools, its murmuring fords, its mysterious end—all are eloquent of Divine deeds, and miracles, and instructions; nor will its voice or eloquence lose its power till the stream of time is lost in the ocean of eternity. Vain, then, are the efforts of the wicked to efface the record of God, or to extinguish the religion which that record teaches. They, indeed, shall perish, but this shall endure, and "the gates of hell shall not prevail against it." While the mountains stand, or the rivers flow, even inanimate nature will thus preach to the ransomed church of God, of his Law and of his Love to man.

The flow of Rivers presents a striking and instructive similitude of human life. "Life bears us on like the stream of a mighty river. Our boat at first goes down the vast channel through the playful murmur of

the little brook, and the willows on its glassy borders. The trees shed their blossoms over our young heads; the flowers on the brink seem to offer themselves to our young hands. We are happy in hope, and grasp eagerly at the beauties around us; but still the stream hurries on, and still our hands are empty. Our course in youth and manhood is along a wider and deeper flood, amid objects more striking and magnificent. We are animated by the moving picture of enjoyments. The stream bears us on, and joys and griefs are left behind us. We may be shipwrecked, but we cannot be delayed: or rough or smooth, the river hastens towards its home, till the roar of the ocean is in our ears, and the waves beneath our feet, and the floods are lifted up around us, and we take our leave of earth and its inhabitants—till of our future voyage there is no witness save the Infinite and Eternal."*

VEGETATION.

And the earth brought forth grass and herb, yielding seed after his kind, and the tree yielding fruit after his kind.

In the foregoing chapters we have traced the footsteps of the Creator in "preparing the dry land"—in describing its coasts, elevating its mountains, furrowing out its water-courses, and overspreading its soil; and now we are called to witness its surface sowed and planted

* Heber.

with a vast and marvellous system of vegetation. In following the creative process we have, thus far, seen but *matter* only—inorganic matter in its various forms; each and every change of form or location, in the air, the earth, and the water, being compelled or impressed by a force from without, "ceasing when that ceased, and never proceeding beyond its compulsory influence, either in direction or degree." But at this point a new phenomenon is introduced, and one incomparably in advance of all that has gone before. Now a new power is seen stirring in matter; a power not only of selection or adaptation, but of assimilation, and, moreover of reproduction. It is here for the first time we witness *Vitality* in any of its forms—a principle so mysterious in its essence, and so wonderful in its influence, as to be forever worthy our most devout study and admiration.

In no department of Nature are the contriving Mind and creative Hand of God more visible than in the vegetable kingdom. Yet, when the question has been put to some who reject the Bible account of creation, whence these vegetable productions, so diverse and so wonderful? they have answered, "They are the results of a *natural tendency* to combination, inherent in the particles of matter." But no such imaginary tendency will serve to explain these marvels of our earth. All plants are formed of similar component particles, varying only in their proportion and arrangement. Now these particles could not have an inherent

tendency to be a thousand different and dissimilar things. If the particles or elements constituting vegetation had a natural tendency to form a Rose, the same particles or elements could have no tendency in themselves to compose a melon or a cocoanut. All tendency, if such a thing existed, must be *specific* and *uniform*; otherwise it would be a tendency *To be* and *Not to be*, which is absurd. A tendency to diversity is an impossibility. No such theory, therefore, can explain or account for the endless diversities of the vegetable world. It is in fact a mere fallacy of words; for not a single tendency of this kind has been proved to exist. Plants are in their structure material machines, constructed of substances taken out of their natural and preceding state, and so conjoined as that each uniformly produces its precise and determinate effect or fruit. Now, as nothing but human skill and workmanship can account for the construction of a watch, an organ, or a telescope, so nothing but Divine agency and intelligence will explain the manner in which the inert particles of matter become combined into a beautiful flower, a fruitful vine, or a stately oak; for a careful examination will soon reveal to us that vegetable arrangements are subject to mathematical laws, not less exact in themselves than those which regulate the movements of the planets in their orbits.

The sacred Historian, it will be observed, here places the creation of the vegetable before that of the animal kingdom; and this is the natural and necessary order

of things, for the latter is dependent on the former for its support. Neither man, nor beast, nor bird, can draw his sustenance directly from the soil; its juices and particles must pass through the laboratory of vegetable organization before they are fit nourishment for animal life. Vegetation could have existed without animals; but animals could not have lived without vegetables. Hence we see the correctness of the Mosaic account in placing plants before animals.

The vegetation of the earth, in the History before us, is described and comprehended under three general divisions: First, Grasses; second, Herbs yielding seed; Third, Trees yielding fruit. And here we have precisely the system adopted by botanists after ages of study, as the true arrangement and classification of the vegetable kingdom. These seedless, and these seed-bearing, and these fruit-bearing plants, are identical with the *acotylidons*, *monocotylidons*, and *dicotylidons* of Linneus, Jussieu, De Candolle, and all modern botanists. And it is both curious and interesting to remark, that a system which it has taken centuries to mature, and which successive botanists have labored age after age to advance to perfection, should at last prove the very same as that enunciated by Moses thirty-three centuries ago; and that naturalists after wandering for thousands of years more and more from this true system, should gradually and unconsciously have returned to it, and never discover the identity until after the return was made! Have we not, then,

in this fact, a pleasing evidence, and one altogether above suspicion, that the pen which traced the history of creation was guided by Him who designed and created the whole vegetable world?

Each of the above *classes* includes numerous *orders*, each order a number of *genera*, each genus many *species*, and every species a number of *individuals* defying all enumeration. So diversified in character, and so prolific in nature, are the vegetable creations, that they have spread and taken possession of every spot and region of the earth's surface. They are found in every variety of situations, and grow under conditions the most opposite and contrary. We see them, in one form or another, spring up and thrive, where beforehand we should have supposed there was neither food nor foothold for them, and should have said their existence was impossible. Some grow and flourish at the bottom of lakes and rivers; many spring up, and not a few of them of rare beauty, in the midst of the sandy and arid deserts; others plant themselves on the naked rock, and send down their roots to draw up their food from the scanty moisture of its crevices. In a word, vegetable life appears to be adapted to every possible situation that the surface of the globe presents—to the bed of the sea, to the cavern of the mountain, to the bare granite, to the cinders of the volcano, to the stagnant pool, and the emerging reef, to the heated sands of the Sahara, and to the frozen regions of the pole. In all these situations vegetable organizations of one kind

or another have been found. What matchless skill do we herein behold in overcoming difficulties and extremes!

Nothing can be more astonishing than the unbounded variety of trees, herbs, and grasses, that adorn the earth; nor can anything more clearly exhibit the abounding goodness of the Creator. Nothing that either the necessity, or the improvement, or the pleasure of his creatures could demand, appears to be wanting. Grasses and herbs, in endless diversity, abound, to meet the various tastes and habits of all living things. Fruit-plants, and fruit-trees, adapted to every climate and soil, proffer food to man, and beast, and bird, in every form and of every flavor. Flowers to delight us with their beauties, and to regale us with their odors. Shrubs and vines, without number, to shade and adorn our habitations. Add to all these the forest trees, which offer to man timber fitted for all the purposes of art and industry—the soft pine and poplar; the hard oak, beech and holly; the light cedar and lime; the heavy ebony and lignum vitæ; the flowery mahogany and rosewood; the tough hickory and elm; the incorruptible teak, and durable yew; and a hundred other kinds adapted both for use and ornament. What munificence is here displayed! The Creator might have furnished the earth with vegetation, and yet have limited himself to a few species of each of the three great divisions; but, instead of this, we scarce find bounds to the variety in each of them. We read that

there are 100,000 different species of plants, and we are bewildered at the thought of the countless varieties of hue, and size, and form, which such a vast host exhibit. But not only do the various species of vegetation thus differ, but even the *individuals* of the same species differ. Of the innumerable myriads of trees, shrubs, herbs and grasses, which cover the earth, no two individuals can be found that are alike in all respects. It is even probable that there is not a single blade of grass in the meadow, nor a single grain of wheat in the field, nor a single leaf in the forest, that will not be found to differ, in some respects, from all its fellows. Such is the diversity with which this terrestrial abode of man has been furnished and adorned.

The general vegetative covering given to the earth is grass; and in this, as in all else, the Divine wisdom and goodness are equally conspicuous. Upwards of three hundred genera, and more than 5,000 different species of grass, grow upon the surface of the earth. This needful sustenance of our herds and flocks, and of the beasts of the forests, is everywhere spread over its dusky soil, and is so constituted as to grow without care or cultivation; nay, in spite of every kind of abuse and violence. Like a living carpet, it covers and adorns the face of nature. Self-propagating, and self-perpetuating, it supplies the wants of every passing age with undiminished abundance. Though ever trodden upon, and fed upon, it still lives. Lay it low to-day with a roller, and to-morrow it is stronger than before.

Mow it with the scythe, and it renews and multiplies its shoots with fresher vigor. Crush it with the foot, and it sends up richer perfume. Bury it through all the winter months, beneath ice and snow, and in the spring it starts forth with all the glowing verdancy of its first creation. It survives every abuse, and seems to exult under all kind of violence and suffering—*a beautiful emblem of the true Christian spirit.* Add to all this its *beauty:* in every landscape it is the most conspicuous object, the ground color on which nature embroiders her varied patterns, and from the midst of which the gay hues of flowers come forth in greater brilliancy, by the force of contrast, to arrest the admiring gaze. A model of symmetry, elegance and strength, is each little spear of grass that pierces the sod and shimmers in the sunshine. "And the flower of the grass"—it is a miracle of design. "The grass of the field"—the very sound carries in it all the charms of nature, all the delights of spring and summer—the silent scented paths—the green banks of the murmuring brook—the waving meadows—the pastures of the meditative shepherd—the verdant lawns, glittering with the pearls of early dew. What a concourse of wonders, and beauties, and blessings, have we, then, even in the grass, that we so heedlessly and constantly trample under foot!

The general *color* given to vegetation is another fact worthy of grateful notice, *a soft and pleasant green.* "Had the fields been clothed with hues of deep red, or

a brilliant white, the eye would have been dazzled with the splendor of their aspect. Had a dark blue, or a black color generally prevailed, it would have cast a universal gloom over the face of nature. But an agreeable green holds the medium between these two extremes, equally removed from a dismal gloom and excessive splendor, and bears such a relation to the structure of the eye, that it refreshes, instead of tiring it, and supports, instead of diminishing its force. At the same time, though one general color prevails over the landscape of the earth, it is diversified by an admirable variety of shades, so that every individual object in the vegetable world can be accurately distinguished from another; thus producing a beautiful and variegated appearance over the whole scenery of nature. 'Who sees not in all these things that the hand of the Lord hath wrought this?'"*

If, from these general features, we proceed to make closer and more minute examination of the vegetable creation, we shall discover, at every step, wonders of wisdom and skill surpassing not only all imitation, but all understanding—we shall find that every green blade that springs from the ground is a magazine of contrivances; that every leaf is a theatre of organized wonders; that every fibre of tree, or straw, or stem, vibrates to the quickening influence of light; that every opening flower holds communion with the distant sun; and that

* Dick's Christ. Phil.

every root that spreads through the humid soil, by a chemistry of its own, selects such elements from the earth as are suitable for the growth and perfection of the plant which it bears—a chemistry so wonderful and infallible in its operation, that, though springing from the same soil, and growing side by side, we never gather grapes of thorns, nor figs from thistles.—We now proceed to notice the general parts and functions of trees and plants, beginning with

1. The Roots. The roots serve two important and special purposes; the first a mechanical one, namely, to attach the plant or tree to the soil, and support it there in its proper position. How this is done need not be stated. Our admiration, however, cannot but be excited, when we consider that the force exerted by high winds upon a lofty and wide-spreading tree, full of leaves, is immense, and yet see how admirably contrived the roots are to take hold upon the ground, and chain it there through all the tempests of the year. But roots have another office; and that is, to select and draw suitable juices from the soil, for the nourishment of the tree or plant. This is done by little protuberances called *spongioles*, situated at the extremities of the rootlets. These spongioles appear to possess the faculty or power of selecting from the mixed constituents of the soil their food, and of rejecting what is unsuitable or hurtful to the plant. The roots of half a dozen plants may be intertwined and matted together in the same mass of soil, yet the spongioles of each will

take up its own peculiar food infallibly. And not only this, but they seem to discern instinctively where spots of earth, rich in food, lie, and will push and stretch toward them, and in doing this will often force their way between the layers of rock, and even through solid masonry.

2. Leaving the roots, we ascend to the LEAVES. The leaf is the principal organ of every plant; from it the tree, with all its parts, is developed. All plants are produced from seeds or buds. Now, the seed in which the plant originates, when carefully examined, is found to be composed of a leaf rolled tightly, and altered in tissue and contents, so as to suit its new requirements. The bud also consists of leaves folded in a peculiar manner, and covered with hardened scales to protect them from the winter cold. And the flowers, the glory of the vegetable world, are merely leaves arranged so as to protect the vital organs within them, and colored so as to attract insects to scatter the fertilizing pollen, and to reflect or absorb the light and heat of the sun for ripening the seed. Some naturalists think they see in the stem also clear indications of its foliaceous origin; and maintain that they are able to show, that even the fruit, in all its astonishing variety of texture, color, and shape, is, in like manner, but a modified leaf. Thus, in all the parts and organs of a plant or tree, from the seed to the fruit, the leaf is found to be the basis; and from this the whole has been developed.

The leaf presents a distinct and accurate *type* of the whole plant or tree upon which it grows. As the builder draws upon the parchment a complete plan of his intended edifice, so the Divine Architect has engraven on the leaf the plan of the tree of which it is an appendage. "Each leaf," says McMillan, "in shape and formation, may be regarded as a miniature picture, a model of the whole plant on which it grows. The outline of a tree, in full summer foliage, may be seen represented in the outline of any one of its leaves. Tall pyramidal trees have narrow long leaves, as we see in the needles of the pine; while wide-spreading trees, on the other hand, have broad leaves, as may be observed in those of the elm or sycamore. The correspondence is remarkably exact, and cannot fail to strike with wonder every one who notices it for the first time. Examining the leaf more carefully, we find that the fibrous veins, which ramify over its surface, bear a close resemblance to the ramification of the trunk and branches of the parent tree; they are both given off at the same angles, and are so precisely alike in their complexity or simplicity, that from a single leaf, or even a part of a leaf, we can predicate, with the utmost certainty, the appearance of the whole tree from which it fell. It has further been remarked, that trees which are feathered with branches down to the ground, have leaves with very short footstalks; while trees that have long, naked trunks, have leaves with lengthened footstalks. In tree, and shrub, and grass, the plant-pattern

is repeated in the leaf-pattern; and, in some instances, the resemblance is very extraordinary."

If we pursue our study of leaves still further, and contemplate their *chemical functions*, we shall find each a marvel and a mystery in itself. Every leaf is an individual, gifted with peculiar powers; its stomata and other organs, constitute a complete laboratory; it absorbs air, and exhales moisture; it elects the carbon, and sends forth as useless the excess of oxygen; it extracts from the sunbeam its chlorophyl, and with it adorns itself in the charms of verdancy. In a word, it embodies in its thin and distended form one of the most wonderful examples of organic chemistry. It is at once full of science and full of poetry.

3. Let us glance next at the FLOWERS. Flowers are the most beautiful productions of the vegetable kingdom; and, as to the delicacy of their forms, the beauty of their coloring, and the sweetness of their odor, seem pre-eminently designed for the pleasure of man, for he alone of all the living tenants of the earth is capable of appreciating them. Indeed, in the flowers, the Divine Hand appears to have combined all the elements of pure and refined enjoyment for his earthly offspring. While they minister to the delight of his senses, they at the same time softly and sweetly read to his mind lessons of innocence and wisdom, well calculated to make him a wiser and better being. Whether we contemplate the symmetry of the stems and leaves, the splendor and harmony of their colors, the delicacy of

their organs, the variety of their tints, or the delicious fragrance they everywhere breathe around us—they exhibit to us wonders and excellencies surpassing all admiration. The statement that "Solomon in all his glory was not arrayed like one of these," may seem to the ignorant a forced expression; but it is in fact one beautifully true. Take Solomon's most admired purple, or take even the finest fabric produced by the utmost ingenuity of modern skill, and view it through a microscope, and it becomes hideous ropes and rags, while "the lily of the field," viewed through the same instrument, becomes infinitely more exquisite in its finish, its beauty and its grace. Flowers are the gems of the earth, the productions of a skill and taste which never fall short of the perfection of elegance.

While the flowers thus diffuse pleasure all around, they at the same time perform several important functions in connection with the reproduction of the species. Among flowers, as in the animal kingdom, is found the distinction of male and female. All flowers are furnished with both *stamens* and *pistils*, either in the same individual, or in two distinct individuals. The several parts of these two organs are formed with evident and striking adaptation to one another. The pistil contains the germ of the seed, which is so constituted as to require, and so fashioned as to be ready to receive the element of fertilization from without; and the stamen is so constituted as to produce, and so formed as to shed that element thereon, and thus perfect the seed,

which are the appointed means to ensure the reproduction of the species while the individual perishes.

In the great majority of cases the stamens and pistils are found on the same plant, the former overtopping the latter, an adjustment which enables the stigma readily to receive the falling pollen as it drops from the anther. In drooping flowers, such as the fuchsia, the relation of these parts is inverted in correspondence with the altered position of the flower—the pistil now overtopping the stamen. In fact, nothing can be more beautiful and impressive than the great variety of adaptations by which, in special cases, communication is secured between the pollen and the pistils. In the common Barberry, the lower part of the filament is so sensitive, that whenever it is touched, the stamen moves forward to the pistil. In the Stylewort, where the stamens and pistils are united in one column which projects from the flower, this column is very irritable at the angle where it leaves the flower, and when touched, it passes with a sudden jerk from one side to the other, and thus scatters the pollen. The process of communication in some cases is effected by the wind; and in others, after a more complicated and ingenious manner, by insects.

It will be interesting to follow this process of fecundation a little further. In order to accomplish it more effectually, the stigma exudes a slightly glutinous fluid, to which the grains of pollen adhere. These grains have each two coats, one of which bursts when the

grain is ripe, and the other, in touching the stigma, elongates itself into the shape of a slender tube, passing downward through the style into the ovary, and so conveying to the germ the vivifying fluid. "The cells of the stigma are beautifully contrived to admit the passage of these tubes, as they are long, and extremely loose in texture, at the same time so moist and elastic as to be easily compressed when necessary. It is so contrived that the minute particles contained in the grains enter slowly to the ovary, as it seems necessary that the fecundating matter should be admitted by degrees. It is also necessary that the tube should enter the foramen of the ovule; and as the ovule is not always in a proper position to receive it, it will be found to erect itself or to turn, as the case may be, while the granules of the pollen are passing down the tubes."*

Now one important office of the beautiful flowers is to protect and cherish these delicate parts and processes of reproduction; and amid all the profusion of their elegance, and the variety of their forms, this end is never for once forgotten. Most admirably do they fulfil this function; as if instinct with parental tenderness, they open their bosoms to the sun, they bend toward him, and not unfrequently follow him in his circuit, that from morning till evening they may receive his full vivifying beams. When night is coming on, or a storm is approaching, if their precious charge is so deli-

* Chambers' Veget. Phys., p. 79.

cate as to be liable to injury by cold or wet, they carefully draw their leaves together, and enclose their sacred trust within a beauteous canopy, which, when the threatening evil is removed, they unfold as before. So vigilant in this duty are many flowers, that they have been observed to shut their petals during an eclipse of the sun, and to open them again as soon as the obscuration was past.

Flowers exhibit many powers and properties which the science of man has never been able to explain. Some will instantly close upon the slightest touch. Some will flutter, as if in alarm, upon sudden exposure to intense light. Some seem possessed of limited powers of locomotion; a certain species of wild oats, when placed upon a table, will spontaneously move; pea-blossoms always turn their backs upon the wind; the heliotrope always faces the sun; the tulip opens its petals when the weather is fine, but closes them during rain and darkness. The pond-lily closes its pure white leaves at night, as it lies on its watery bed, but unfolds them again in the morning. On the other hand, some flowers open only at night; that splendid flower, the night-blooming cereus, is of this kind; it opens but once, and that in the night, for a few hours only, then wilts and dies without ever admitting the light of day into its bosom. Some open and shut at certain hours, and that so regularly as to indicate the time of day, like the sindrimal of Hindostan, which opens at four in the evening and closes at four in the morning. Dr.

Good, in his *Book of Nature*, describes a water-plant, *valisneria spiralis*, which, at a certain season, detaches itself from its stem, and, like a gallant suitor, sails complacently over the waters in pursuit of a mate, till he find her. Other flowers there are, as the *nepenthes*, that will adroitly catch flies and devour them. Others again possess a most extraordinary luminous property; the *nasturtium*, if plucked during sunshine, and carried into a dark room, will there show itself by its own light; a plant that abounds in the jungles of Madura illumines the ground to a distance all around; and many species of lichens, creeping along the roofs of caverns, lend to them an air of enchantment, by the soft and clear light they diffuse. Who can explain to us these phenomena of flowers? Who but must see that the hand and counsel of Infinite Wisdom are concerned in the production of these vegetable wonders!

I add but one fact more respecting flowers, and that is, *the power which each flower has to regulate for itself the heat of the sun*. It is well known that objects reflect or absorb heat from the sun according to the shade of their color—that a perfectly white surface will reflect or throw back all its rays, and remain comparatively cool beneath them through a whole summer's day—that a dark-colored object will absorb part, and reflect part, and be heated in proportion to the darkness of its shade—and, that a perfectly black surface will absorb all the rays, and become quite hot in the sun. And this property of colors reveals to us a most beautiful

arrangement in the constitution of flowers. "To every plant," says the author of *The Poetry of Science*, "that spreads out its leaves to the sunshine, and to every flower that lends its beauty to the earth, is given that particular shade and color that will measure for it the precise degree of heat which its own peculiar constitution requires. The chalice-like cup of the pure white lily, floating on the lake, the variegated tulip, the delicate rose, and the intensely-colored dahlia—have each powers peculiar to themselves for drinking in the warm life-stream of the sun, and for radiating it back again to the thirsty atmosphere." And thus every plant is endowed with functions which silently, but unerringly, determine the quantity of heat which it needs, and the relative amount of dew which shall wet its leaves and its flowers. The outward form and color of a flower, indeed, delight our eye and excite our admiration; but when we come to contemplate this wonderful arrangement, which so happily regulates the power of the sunbeams that are incessantly poured into its delicate bosom, our wonder must be raised to the higher feeling of profound adoration toward the Great Designer and Maker of all.

Such are the floral creations. And now, what could exceed them in beauty or perfection? Nothing, in form, function, or constitution, is defective; nothing is left to chance or accident; but every organ, every process, every property, to its most minute and insignificant details, is manifestly contrived and perfected by

omniscient and unerring skill. Who can set his eye upon a flower, delicate, and beauteous, and fragrant, and lay his hand upon the damp and dusky ground from which it springs, but must exclaim, with the pious peasant of Scotland, "What but almighty power could extract this from that!" And when we observe that each of the tiny bristles of the leaves, and even each shadowy down of the petals, too minute for the unaided eye, is measured and planted with undeviating discrimination and precision, can we doubt the truth, or refuse the consolation, of the Saviour's assurance, "The very hairs of your head are all numbered?"

4. Following the order of nature, we are next brought to notice the SEEDS. Here opens before us another field of great interest. A seed, a grain of seed, as commonly regarded, is but an insignificant object, and attracts but little attention; yet that grain of seed, within its small circumference, and beneath its dusky rind, embodies an organization possessing properties which the united wisdom and ingenuity of mankind could never produce. In the seed lies the future plant in miniature. The whole of the beauteous lily, which engages the admiration of every beholder, once lay folded up within a little dingy bulb; its leaves and blossoms are only a development of what was hidden within the scales of that unattractive root. And within the narrow compass of the acorn are folded up, with infinite nicety, all the rudiments of the towering oak.

The origination of the seed in the bosom of the

flower has already been described. As soon as that step has been fully accomplished, the flower decays, while the *seed-vessel* forms, and increases in bulk. And now let us devote a moment to look at the admirable contrivance of these vessels, or capsules, in which the various seeds are lodged and protected while they mature. These are so many, so diverse, and often so complicated in their forms and materials, that it would seem as if they had been adopted only for the sake of demonstrating the inexhaustible resources of the Divine invention. Some are invested in close tunicles, some are surrounded with hard shells, some are elaborately folded in leaves, some are deposited in rows within parchment pods, some are in cases lined with softest velvet, some are wrapped in wool, some are held as in blown bladders, some are placed between hard scales, some are defended by pointed thorns, some are housed as beneath a roof, some are within slits made in the edge of the leaves, some are buried in the heart of the fruit, and some in various other manners. So diverse are the ways in which Infinite Wisdom can accomplish its purpose with equal ease and equal success.

The *fecundity* of plants, or their capacity for producing seed, presents us with another remarkable fact. The common cereals often yield from sixty to a hundred fold. One castor oil plant will produce 1,500, one sunflower 4,000, and one thistle 24,000 seeds in a single season. From one grain of maize, or Indian Corn, if it and all its produce were from year to year planted and

duly cultivated, in favorable soil and climate, sufficient seed might be raised in *five years* to plant a hill of corn with three grains on every square yard of dry land upon the face of the globe; and in *ten years* sufficient to plant the whole solar system in the same manner! Such were the import and efficacy of the creative fiat, "Let the earth bring forth herb yielding seed after his kind." And this unbounded fecundity is one of the many demonstrations we have in creation of the goodness of God, who has thus made abundant provision, not only to perpetuate vegetation, but also to meet the wants of all his creatures.

Another interesting fact connected with seeds is the arrangement made for their *dispersion*. If all seeds were to drop, and remain upon the spots where they are produced, they could never germinate, nor be of much avail if they did. Adequate means for their dissemination, therefore, were all-important; nor was this point overlooked, multifarious as were the works of this day. Most interesting and beautiful are the contrivances employed for this end. Sometimes the pericarp, or the vessel containing the seed, opens elastically, as with a mechanical spring, and discharges the seeds contained in its cavity to a considerable distance. The *hura crepitans*, of the West Indies and South America, opens its pericarp with a report loud as that of a pistol, and scatters its seed with a great force. Some seeds, as those of the thistle and dandelion, are provided with a beautiful stellate down, which serves as wings, and

by means of which they often travel many miles. The spores of the ferns and mosses have been constituted so minute and light that they rise in the atmosphere, and are conveyed by the winds across seas and oceans. Other seeds, as the burdock, are furnished with little hooks, by means of which they cling to men and beasts as they pass by, and are thus scattered far and wide. Other seed still, like those of the milk-weed and willow-herb, are hairy, and so are easily lifted by every current of air, and carried to a distance. Birds, also, are important agents in this great work; birds are natural planters of trees; crows have been seen planting acorns over wide tracts of land, from which have sprung valuable groves of oak. Add to all the above the fact, that the seeds of many berries, and of small fruits, will grow after passing through the bodies of birds; and as many of the feathered tribes in autumn, when the seeds are ripe, migrate from north to south, they often void the seeds they have eaten at the distance of hundreds of miles. Some seeds are covered with a viscid substance, by which they adhere to whatever touches them, and in this manner are carried from place to place. Many of the heavier seeds, such as acorns, are gathered and buried by mice, squirrels, etc., of which, while part is consumed, many are left in the ground to germinate. Rains, and rivers, also, often carry seeds hundreds and even thousands of miles from where they were produced; and the ocean not unfrequently bears them to the shores of other continents, or wafts them

upon the coral islands just risen from its bosom, and thus soon covers them with vegetation. In these various ways was the surface of the earth overspread with the vegetable creations of the third day; and, as we may well suppose, the work was not very long in being accomplished.

The seed having been dispersed and dropped in the soil, the next process to be noticed is its *germination*. To this certain conditions are necessary. A certain degree of heat must be had; at a temperature below freezing point, seed will not germinate, and if the temperature be up to, or very near, the boiling point of water, it will not germinate, but die. The most suitable temperature for each particular plant varies between these limits according to the nature of the plant. Again—if seeds have the necessary warmth and moisture, yet if exposed to bright light, they will not germinate; shade is always, absolute darkness sometimes, necessary for the success of the germinating process. If the seed enjoys all the required conditions of shade, water, air and heat, it will grow and flourish. When a seed, a grain of wheat, say, is cast into the ground, from one end of it issues a plumule, or tender sprout; from the other a number of fibrous threads; the plumule immediately tends upward, and works for the air and light, and becomes a plant; the fibres also at once struggle downwards, and become the roots. "Now, what is a little remarkable," says Paley, "the parts issuing from the seed take their respective di-

rections, into whatever position the seed itself happens to be cast. If the seed be thrown into the wrongest possible position, that is, if the ends in the ground point the reverse of what they ought to do, everything, nevertheless, goes on right. The sprout, after being pushed out a little way, makes a bend and turns upwards; the fibres, on the contrary, after shooting at first upward, turn down." This fact is not more wonderful than it is important; for, how unprofitable would be the labors of the husbandman, if only the grains that happened to be right end up would prove productive, for scarce one seed out of a hundred would be found in this position. Or, how endless would be his toil, if he had, with care, to place each particular seed in the ground with plumule end up. But for the present wise and happy constitution of the seed, by which each part proceeds in its right direction, and to fulfil its appointed office, where would be our daily bread? How manifest both the wisdom and goodness of God in this thing.

The *longevity* of seeds, or the power which they possess for retaining the vital principle for lengthy periods of time, is another remarkable fact to be noticed here. This is an important provision, as it supplies a safeguard against the extinction of the species under unfavorable circumstances, which may often occur. If the condition of things *now* will not permit the little seed to germinate and grow, it still retains its vitality, as if hoping for a better day. A grain of mustard seed has been known to lie in the earth for a hundred years,

and as soon as it had acquired a favorable situation, to shoot as vigorously as if just gathered from the plant. Seeds of wild-flowers, buried beneath mounds that have existed from time immemorial, as soon as exposed to sun and rain, have sprouted forth as vigorously as if they had been the produce of last summer. The lapse of ages will not extinguish life in some of the most valuable seeds. Several examples of this were given on a former page;* I will, therefore, add only one more. "In the time of the Emperor Hadrian, a man died soon after he had eaten plentifully of raspberries. He was buried at Dorchester. About thirty years ago the remains of this man, together with coins of the Roman Emperor, were discovered in a coffin at the bottom of a barrow, thirty feet under the surface. The man had thus lain undisturbed for some 1700 years. But the most curious circumstance connected with the case was, that the raspberry seeds were recovered from the stomach, and sown in the garden of the Horticultural Society, where they germinated and grew into healthy bushes."† What a wondrous creation, then, have we in a grain of seed! What a mystery is its life, that can thus well nigh immortalize its tiny and delicate organism, preserving it uninjured and unchanged through the lapse of hundreds and thousands of years! As plainly do the small and dusky seed in the soil, as the most brilliant orbs in the heavens, proclaim, "The Hand that made us is Divine."

* See p. 62. † Benedicite, p. 266.

5. The Edible, and other Useful productions of plants, is another subject that demands our grateful consideration. Here opens before us a field of unbounded munificence—here is everything good for sustenance, pleasant to the taste, and delightful to the eye; here is food to nourish us, materials to clothe us, and medicines to heal us. Nowhere in the visible creation do we behold a more striking display of the indulgent beneficence of our Father in heaven than in the fruits of the earth. Here we find not only an abundant provision made to meet our actual wants, but an endless variety to gratify our tastes, and to enhance our pleasures. God might have limited our food to a few comparatively insipid roots, tubers, and bulbs in the ground; but, instead of this, He has appointed plants, herbs, shrubs, vines, and trees of every imaginable description, to produce and bring forth fruit after their kind for the service of man. He might have made all these of the same, or nearly the same, taste; but so far from this was his Divine generosity, that we have almost an interminable variety of fragrance and flavor, of sweetness and acid, of mellowness and pungency; and all so wonderfully suited to gratify our taste, to stimulate our appetite, and to yield us every required and desirable nutriment in health and in sickness. He might have so constituted fruit trees and plants as that their production would be confined to one particular kind of soil, or one special climate; but, instead of this, He has adapted them, in one form or

another, for all soils, and for every habitable climate of the globe, so that all His children may be sharers of His bounties. Moreover, He might have so arranged the vegetable creation as that all the fruits and productions of the earth should mature and ripen at the same season, but His Divine wisdom and goodness have strewn them along in succession through all the months of the summer half of the year, so as constantly to yield us a fresh and varied supply.

To the foregoing properties of fruit-bearing plants and trees we must add another important one—*their capacity for improvement.* The Creator might have so made these as to be unchangeable in their character, unimprovable by any art or effort that could be brought to bear upon them; but in his wisdom and kindness He has so constituted them as at once to stimulate the ingenuity and reward the industry of man, by being susceptible of improvement and variation without limit. And mark the happy results of this constitution of things. Wheat, in its native state, is but an inferior and straggling seed, and may be found now in this condition on the French and Italian shores of the Mediterranean, under the name of *ægilops;* but by long years of patient and prudent cultivation, this has been brought to our present plump and prolific wheat. The same is true of potato, turnip, cabbage and many other useful vegetables. The crabapple, in its native state small and sour, by pruning, grafting, fertilizing the pistil of one tree with the pollen of

another, and various other means, has been improved and brought to the present magnificent fruit of our orchards. By similar processes, the mountain ash, instead of its acid and unwholesome berries, has been made to yield the sweet and juicy pear; and from no better parentage than the acrid sloe have been derived our most luscious plums. Who can be blind to the wisdom, or insensible to the goodness displayed in this constitution of herbs and trees?

Plants not only feed, but *clothe* us. A variety of cloths are fabricated from grasses, flags, and the inner bark of trees. But among the most useful plants for this purpose is the common flax. In the flax plant, the Creator has provided man with a material for thread and cloth of a most suitable and durable quality. And that our whole race might avail themselves of its benefits, He adapted its constitution to nearly every region of the globe. More valuable still, if possible, is the cotton plant. This also is widely disseminated—it flourishes in India, in Egypt, in North America, and in numerous other regions. Of the commercial value, or of the various and beautiful fabrics manufactured out of this article, I need not speak. Suffice it to say, that through the perfection of modern machinery it has become the great clothing staple of the world.

We have now traversed the field of the vegetable creation, hastily it is true, yet what a multitude of beneficent designs, wonderful contrivances, and valuable productions have we seen! And how replete with

lessons of wisdom are these all! Many of these lessons have been pointed out in the course of the foregoing illustrations; but a number of other and more general reflections, here at the close of our survey, naturally suggest themselves, and to a few of which we now desire the attention of the reader.

REFLECTIONS.

In vegetation we have the productions of Divine Chemistry! Out of the same elements we here behold the utmost diversity of results. Ten thousand species of herbs, plants and trees, springing from the same soil, watered by the same showers, surrounded by the same atmosphere, and warmed by the same sun—yet how different in their qualities! Some are acid and some are tasteless, some offering the richest nourishment and others the rankest poison, some are exhilarating and some stupefying, a few are as sweet as honey and many as bitter as the waters of Marah, some secreting oil while others are exuding gum, some sending forth odors that delight and some those that sicken and offend—yet all these are constituted of the same four or five primary elements, the diversity arising simply from the different proportions in which Infinite Skill has combined them. And herein is chemistry which man, astonishing as his progress has been in this science, can neither imitate nor approach. Man, indeed, can take a plant and separate these its elements, and ascertain their exact proportions, but he

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can never recombine them so as to restore the plant. This is God's prerogative.

"What a thought that was, when God thought of a tree!" exclaimed a philosopher. Yes, a tree, a single tree, originating in an atom seed, deriving its vitality from heaven, drawing its juices from the earth, feeding upon the air, eliciting its coloring from the sunbeam, and elaborating its several parts by the mysterious power of its own vitality—presents a concourse of contrivances and properties and functions such as would never have entered the mind of man, or perhaps of any other intelligence, had not God set it in living form before him. What conceptions, then, shall we form, and what sentiments entertain of that MIND, who with unerring foresight, contrived a thousand, yea a hundred thousand differing trees and plants—differing in their size from the invisible lichen of the naked rock to the expanded banian tree of India, which proffers beneath its shade ample room for an army—differing in form from the creeping vine to the cedar of Libanus—differing in their age and duration from the ephemeral "flower of the grass" to the mighty adonsonia, hoary with the mosses of more than twenty centuries—differing in their juices from the nourishing grape to the pohon upas in their deadly valleys—differing in their aspect from the serpent cactus to the stately pine—differing in their habitations from the climbing lianas of the Guinea forests to the confervæ of the silent pool—differing in the structure of their

roots, in the form of their leaves, and in the texture of their stems—differing in their flowers, and seeds, and fruits—differing in the rapidity of their growth, and circulation, and decay—differing in their qualities for absorbing and reflecting the heat of the sun—and, differing in a multitude of other particulars! In the vegetable kingdom we behold a diversity all but endless. In their creation, then, what countless ends to be secured. What an infinitude of influences, properties and agencies to be determined. And what an infinitude, too, of weights, and measures, and proportions to be calculated. Yet in the Divine Mind, as in a vast storehouse of glorious ideas and designs, the plans of all were perfect and complete ere ever the omnipotent word to clothe the earth with verdure had gone forth. In that plan nothing was forgotten, nothing overlooked. No unforeseen difficulty arose, no part of the Divine purpose failed, no tree or plant or blade of grass came short of its designed perfection. When on the evening of this day, God's all-seeing eye surveyed the whole, He pronounced the work all very good.

We have seen that every plant that springs out of the ground abounds, from root to leaf, with contrivances of exquisite skill and nicety; and since every contrivance must have a contriver, and no contriver beneath the Deity could produce those of vegetation, it follows, therefore, that every individual plant and vegetable is the immediate work of God. They neither

spin, nor weave, nor paint themselves. Wherever, then, we behold growing a tree, or plant, or bush, there God himself is patiently and unremittingly at work. He is present with every flower that springs up in the garden, or the field, or the wilderness, and gives to it with His own hand every leaf that adds to the grace of its fashion, and every tint that contributes to the beauty of its coloring. He presides over it from the first impulse of germination to the last moment of its fading existence. How natural, then, and how conclusive, too, is the inference, that if God thus cares for each blade of grass, and each flower of the field, much more will He care for those whom He hath created in His own image, redeemed by His own Son, and renewed and sanctified by His own Spirit. How sweetly does our Saviour deduce for us this comforting lesson—"Consider the lilies of the field, how they grow; they toil not, neither do they spin; and yet I say unto you, that even Solomon in all his glory was not arrayed like one of these. Wherefore, if God so clothe the grass of the field, which to-day is, and to-morrow is cast into the oven, shall he not much more clothe you, O ye of little faith?" How simple the argument, how convincing the inference.

Vegetation has its *admonitions* as well as comfortable assurances. The *zizania*, translated "tares" in our Lord's parable, was a species of bastard wheat, that, in the first stages of its growth, bore a very close resemblance to genuine wheat; hence the servants never

discovered, or even suspected its existence, until the ear was formed and the fruit brought forth. Up to that point both had passed for wheat. So often among men: outwardly there may appear little or no difference between the righteous and the wicked; side by side they may move in the world and stand in the church, and all things may seem to come to both alike. But between the two, as with the tares and wheat, there is an essential and germinal difference, which the eye of Omniscience, at the harvest time of souls, will not fail to detect.

In the wheat-field is to be found, sometimes, another instructive phenomenon. I refer to a species of blasting, which farmers term *bunt*, but botanists *ustilago fœtida*, on account of the putrid and intolerable odor it exhales. This evil confines its ravages to the *grain*. Externally, the infected ear exhibits no sign of disease, no rusty appearance or stunted growth; on the contrary, it seems full as plump and green as the sound ears. Stealthily and secretly is the process of corruption accomplished; and not till the harvest is reaped, and the wheat is brought to the threshing-floor, is the discovery made, by the odor and color, that the produce is unfit for the master's use. Under this mask of health and soundness there is found nothing but black and fœtid powder, nauseous and offensive. And such is the latent infection of *sin*. Men may appear fair and sound on the field of life—may pass through the world in robes of unspotted reputation, and even be adorned

with the verdant blades of envied fame—but whose hearts, when laid open in the presence of God, will be found, like the fœtid wheat, wholly corrupt, offensive in his sight, and a stench in his nostrils.

But we need not seek for rare or out-of-the-way productions to gather lessons—every green thing that springs out of the ground is a preacher to us, if we would but listen to its voice. All the *leaves* of the forest join in one general murmur to repeat in our ears the prophet's warning, "We all do fade as a leaf." And as we are so prone to thrust this truth out of mind, as comes on every fading Fall of the year, God spreads before us on plain and hillside a great parable, in which our own decay and death are pictorially represented in such a vivid and impressive manner, that he who runs may read, and he who reads must reflect and profit.

"Like leaves on trees the race of man is found,
Now green in youth, now withered on the ground;
Another race the following age supplies;
They fall successive, and successive rise;
So generations in their course decay;
So flourish these when those have passed away."

With the leaves join the beauteous *flowers*, like whispering angels, to impress the same needful admonition upon the heart and mind of man. "As a flower of the field, so he flourisheth." And each flower along his path seems to look up and address him in language of its own, and say—

"Child of the dust, like me you spring,
A bright but evanescent thing;
Like me may be cut down to-day,
And cast a worthless weed away."

The *grass* also has its speech. It spreads itself before us like a living allegory, in which we may see our image and our end. It says, "All flesh is grass; in the morning it flourisheth and groweth up; in the evening it is cut down and withered." And when its beauties and benefits, and teachings all can avail man no more, the *green grass* reverently spreads itself as a robe over his slumbering form, and forsakes not even that upon which all others have turned their back—*His grave*—remaining there, in each bright blade, a perpetual TYPE of a coming glorious resurrection!

The Fourth Day.

The Sun, and the Moon, and the Stars are revealed.

THE FOURTH DAY.

GENESIS 1: 14–19.—And God said, Let there be lights in the firmament of the heaven, to divide the day from the night; and let them be for signs, and for seasons, and for days, and years. And let them be for lights in the firmament of the heaven, to give light upon the earth: and it was so. And God made two great lights; the greater light to rule the day, and the lesser light to rule the night; He made the stars also. And God set them in the firmament of the heaven, to give light upon the earth, and to rule over the day, and over the night, and to divide the light from the darkness: and God saw that it was good. And the evening and the morning were the fourth day.

THE great works of this day, like those of the preceding days, are described, not scientifically, but as they would have *appeared* to an observer had one been present. The narrative of the sacred historian is *scenic*, or an account of things as they would have appeared to a human spectator.

And God made two great lights. In the Hebrew Bible, the word here translated "made," is not the same as that rendered "created." It is a term frequently used in Scripture, and signifies *constituted*, or *appointed*. Thus we read, "The Lord made the Jordan a border between the tribes;" that is, appointed the Jordan a boundary line between them. So here, *God made two great lights to give light upon the earth;* that is, appointed these two great lights to give light upon the

earth. It is not said that they were now *created*, but that now, having been revealed in their brightness for the first time after the chaotic darkness, they were constituted and appointed to be henceforth the lights of the world. These great luminaries were created, doubtless, long ages before. They had given light to the earth through the vast pre-Adamite periods of its history, and from the sun proceeded what degree of light prevailed upon its watery surface on the first, second and third days of this new creation. But up to this time the globe was encompassed by a sea of thick clouds, floating in the upper regions of the firmament; so that the orbs of the sun and moon were altogether invisible, and only a portion of their rays struggled through, to create the feeble daylight. What was on this day done was the removing of this cloudy pall, the clearing of the firmament into a pure azure sky, so as to disclose the moon in her brightness, and the sun in his unobscured glory. And these luminaries, thus suddenly and for the first time breaking into full view, would appear to a spectator upon the earth as *new creations;* and as such they are here described. They are said to be now "made," that is, appointed to give light upon the earth.

That the sun was not created, or called into existence on this day, will be obvious on a moment's reflection. If we adopt what is called the Nebular Theory of the origin of the universe, then to suppose that the earth was created before the sun, is as absurd as to hold that

the offspring was born before its parent; for on that hypothesis the material of the earth was thrown off from the revolving mass of the sun. But setting that theory altogether aside, this fact remains unquestioned —that our earth is a member of the solar system, a globe, dependent, in common with the other planets, on the sun, held in its place and governed in its motion by the powerful attraction of the sun; and, therefore, could no more have existed before the sun than the eyeballs before the head, or the branches of a tree before its roots. Hence, for this, together with the other reasons already stated, we say, that the work of the fourth day was not the *absolute creation* of the sun and moon, but the revealing of them in their brightness after their previous obscuration.

Two great lights. The moon is called a *great* light, from its being apparently equal, or nearly equal in size to the sun; or, perhaps, from the fact that it seems much larger than the stars. But here, again, things are described as they would appear to a spectator, and not as they were in reality; for the moon is among the very smallest of the heavenly bodies; and, as compared with the sun or fixed stars, is but as a grain of mustard seed to a twenty-four inch globe.

The greater light to rule the day, and the lesser light to rule the night; that is, each was to shed its light in its appointed season, for the benefit of the new-made world.

And let them be for signs, and for seasons, and for

days, and years. These great luminaries by their ever-recurring revolutions, oscillations, and eclipses, would be *signs* to all living of the supporting and guiding power of God, *signs* to the mariner of his course on the trackless deep, *signs* to the husbandman for sowing his seed and gathering his harvests, *signs* to the traveller in tracing his path through the gloom of the forest, or over the wilds of the desert. *And for seasons*—by their steady progress in their appointed orbits they would bring on spring, summer, autumn and winter in their due rotation. *And for days*—by their established revolutions they would measure out the alternations of day and night. *And for years*—this grand division of time by which all succession of duration is distinguished, they would also continue to describe and determine without cessation or mistake.

The arrangement which thus measures out time by days, and months, and seasons, and years, is one of supreme wisdom and beneficence; for these revolutions are the means by which we gain our knowledge of the flight of time. Our artificial time-keepers owe their conception to the apparent motion of the sun; our clocks and watches are but transcripts or miniature imitations of the celestial revolutions. And ingeniously contrived and admirably made as they sometimes are, being like every other production of man imperfect, they would soon be of little value if we could not *regulate* them by the same undeviating motions of the heavens. But for the celestial revolutions we should

have but a confused and imperfect idea of the lapse of time. If God had chosen to create our planet *a world at rest*, and illumined by a sun fixed and immovable in mid-heaven, the earth would have been a world without times or seasons. Spring, summer, autumn and winter would be unknown; the alternation of day and night would have no existence; and the lapse of time we now call a year, would glide away without giving us the least intimation of its beginning, or progress, or close. In fact, we should have no distinction or measure of time whatever, except in the succession of our irregular thoughts, or ever-fluctuating experiences. In pain or sorrow the space of a day would seem as long as a week; and a week, exhilarated with joy or pleasure, would glide away as one day. In childhood the space of a month would appear as long as a year in manhood. So that no man could tell his age, or say at what period of life he had arrived. He would have no better idea of the flow of time, or of life, than a passenger below deck would have of the speed with which he sailed. Time, indeed, would pass away as swiftly and as uniformly as at present, but the universe would be without a dial plate to mark its progress, or to give man warning of his hasty passage to eternity. Compared with such a condition of things how admirable the present arrangement; now the rising and setting sun, the changing moon, and the revolving stars, by their uniform and perpetual revolutions, continually apprise man of the swift flow of his appointed

time on the earth. These changes of days and years are to him the minute and hour hands of nature's clock-works; and each as it completes its round tolls in the High Belfry of the heavens its own death and departure, thus giving him warning that his own is daily approaching.

The creations brought before us for illustration in this day's history are the heavenly bodies—the sun, and moon, and stars—a field glorious as it is boundless.

THE SUN.

And God made the Greater Light to rule the day.

The true character of the sun was learned by slow and laborious steps. Through a long series of ages, indeed until comparatively recent times, the common idea was that the earth was the centre of the universe, and that the sun, and moon, and stars, revolved around it. And most ingenious was the logic and complicated the theories put forth to account for their apparent motions on this supposition. To this task many of the ablest minds, whose names adorn the pages of history, devoted themselves with unwearied perseverance. Not less than twenty-six solid but transparent spheres were conceived to revolve within one another, carrying along with them the sun, the moon, the planets, and the fixed stars, at different velocities. This conception was carried to the meridian of its glory in the first

GENERAL SKETCH OF THE SOLAR SYSTEM.

century of the Christian era, by Ptolemy, a great mathematician of Alexandria, and after him was named the Ptolemaic System. This was the generally accepted theory for many centuries after the death of Ptolemy. At length the true idea that the sun was the real and immovable centre dawned upon the mind of Copernicus, whose views were embraced and advanced by Galileo, Kepler, and others, and were finally perfected and established by the splendid discoveries of Sir Isaac Newton, who, in the year 1687, presented the world with a convincing demonstration, that not only our globe, but also a vast and magnificent system of others, revolved at different distances and with different velocities around the sun as their fixed and common centre.

The position and relation of the sun being now established, his *distance* from us next became a subject of intense study. And it was soon found to be removed from the earth no less than 95,000,000 miles. Recent calculations, however, make his mean distance to be 92,000,000 miles. Now this is a space so vast as to be altogether beyond the power of the mind to grasp, except as it is compared with some more familiar measurements. He who has travelled round the earth is regarded as having accomplished a journey of prodigious length; but to pass over a distance equal to that of the earth from the sun, he would have to repeat that journey 3800 times. Or, take another comparison. If a

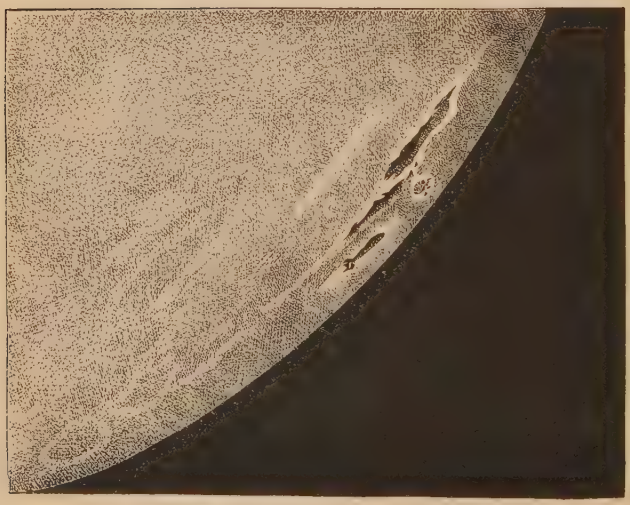
man on the day Columbus discovered America had started, we will suppose, by some aerial conveyance for the sun, and travelled at the daily rate of 500 miles, he would not have completed his journey at this day, but would have to continue his progress for 120 years yet to come, before he would alight on that resplendent globe.

The next point to be determined was the *size* of the sun. This, also, was found to be on an equally enormous scale, his diameter being 882,000 miles, or more than 111 times that of the earth, and his circumference 2,764,000 miles. But these are dimensions too great for us to form any clear or definite idea of them. Let us again resort to comparison. The globe we inhabit is an immense ball, filling a circle, nearly 8,000 miles in diameter; around us sweeps the moon, describing a far mightier circle, at the distance of 240,000 miles; now let us suppose the earth to be enlarged until it completely fills this circle of the moon, and what a stupendous globe it would then be. Yet to be equal to the sun it would have to swell out on every side 200,000 miles even beyond this orbit! Or, to change the supposition—"Were the sun a hollow sphere, perforated by a thousand openings to admit the twinkling of a luminous atmosphere without, then a globe as large as the earth might be placed at the centre, with a satellite as large as the moon, and at the same distance from it as she is from the earth; and there would be presented to the eye of a spectator on the interior globe, a universe as

extensive as the whole creation was conceived to be in the infancy of astronomy, and as splendid as the heavens appear at present to the uninstructed gazer!" The materials composing the body of the sun, if divided and moulded, would form no less than 1,384,000 globes equal in size to the earth. And its mass is more than 500 times greater than that of all the planets and satellites put together. Such is the magnitude of the greater light. See Fig., page 241.

Our knowledge of the *constitution*, or real nature of the sun, is still quite limited and defective. He is now generally considered to be an incandescent body, encompassed by two atmospheres, the inner of which is believed to be non-luminous, while the outer one floats over it, and is highly luminous, and forms the bright disk of the sun. This luminous atmosphere seems to be all ablaze, and in constant agitation, as if with mountain waves of living fire. Recent experiments made with the Prismatic Spectrum have revealed the striking fact, that several of the metals found in the globe we inhabit, enter also into the composition of the sun; among these are iron, magnesium, sodium, chromium and nickel. This stupendous and flaming orb, like all the planets which it lights up, rotates upon its axis, its period being 25 ds., 7 hrs., 48 min.

When viewed by the unaided eye, the sun presents a clear surface, without spot or wrinkle; but if we look upon it through a telescope, we shall discover on its disk a variety of phenomena. The most notable of these



SPOTS AND FACULÆ OF THE SUN.

are certain *black spots* that prevail in its middle or equatorial zone. At times its disk is almost, if not altogether, clear of them; then, again, fifty or one hundred may be seen at once. When watched closely from day to day, or from hour to hour, they appear to enlarge or contract, to change their forms, and at length to disappear altogether, or to break out anew in parts of the surface where none were before. Many of them are of immense extent, being five, ten, or twenty thousand miles in diameter. Spots of 2,000 miles extent have been observed to vanish in twenty-four hours; and one measuring 45,000 miles across has been seen to close up in six weeks, thus contracting its area at the rate of more than 35,000,000 square miles per day. On the other hand, spots larger than the circumference of the earth have been formed in forty-eight hours, where not a trace of one was visible before. It has been ascertained that the prevalence of these extraordinary spots is periodical; that is, from minimum to minimum, or from the time of the least number of them to the time of the least number is 111 years, being exactly nine periods to a century. As to their nature, it is supposed that they are openings or ruptures in the strata of the solar atmosphere, produced by some prodigious agitations or storms therein; and that the dark nucleus is the shaded body of the sun itself, as seen through the aperture.

In the neighborhood of the above described spots, large spaces of the surface are often observed to be

covered with strongly marked curved or branching streaks, more luminous than the rest, called *faculæ*. These are regarded with probability as the ridges of immense waves in the luminous atmosphere, and indicate violent agitation in their vicinity. In 1859, two intensely luminous bodies, resembling vast clouds, far more brilliant than the general surface of the sun, suddenly burst into view, and after travelling, side by side, a distance of 35,000 miles, disappeared almost instantaneously. They were seen only for about five minutes.

During total eclipses of the sun, another wonderful phenomenon has repeatedly been observed, in the form of enormous flames, shooting upward above the solar surface to the appalling height of thirty or forty thousand miles; these are sometimes rose-colored, sometimes white, and sometimes red; and they are supposed to prove the existence of a rarified atmosphere outside and above the luminous envelope or photosphere.

The sun is the centre of *gravitation* in the planetary system. Gravitation is a power or property with which all matter is endued. It acts according to the same laws between the most minute particles, and the most stupendous bodies. Always and everywhere its force is in proportion to the mass, but diminishes inversely as the square of the distance between attracting bodies increases. It is transmitted instantaneously from one body to another, and it acts equally upon bodies in a

state of rest, and upon those that are in swiftest motion. It is gravitation that holds together the particles that compose a dew-drop or a pebble, and it is the same mysterious power that binds the materials of the earth in one solid globe. It is gravitation that brings down the rain from the clouds and the avalanche from the Alpine summit. What we familiarly call *weight* is the measure of gravitation. A man's weight is the amount of force with which the earth attracts him to its surface. But for gravitation our dwellings and ourselves would be flung from the earth's circumference never to return by its rapid rotation on its axis, like the mud and water from a carriage wheel in rapid motion. And it is by this all-pervading power, emanating from the sun, that the earth and the other planets are held in their respective orbits, while moving with inconceivable velocities.

The revolutions of the planets are effected and governed by two antagonistic forces—*gravitation and centrifugal impulse;* the operation of these may be made plain by a familiar illustration. If a leaden ball be whirled round at the end of a string, it will stretch the string by its centrifugal force, or tendency to fly from the centre; that force will be increased as the speed of rotation is increased; and the velocity may be so accelerated as to overcome the strength of the string and break it. The instant that takes place the ball forsakes its circular course, and flies off in a tangent, or straight line. But let us suppose the velocity to be

increased only just up to the limit of the string's capacity; then the centrifugal force and the strength of the string are equal, or evenly balanced, and the ball goes round and round. Now this is precisely the condition of the earth and the planets as they move in their orbits. Were the progressive motion of the earth suddenly to cease at any point of its orbit, that moment, under the force of the sun's gravitation, it would begin to descend towards him, and in sixty-four and a half days would fall with a crash upon his surface. On the other hand, were gravitation to cease, that instant our globe would forsake her circular path, and like the ball rush forward in a straight course into the depths of space. The gravitation of the sun performs the office of the string, drawing it inward at every instant of its progress, and thus compelling it to pursue a circular course. And the attractive force thus exerted upon it is exactly equal to the centrifugal force at every point of its orbit. And calculation proves this attractive force to be enormous. Were gravitation suspended, and our globe, moving as it does, at the rate of 68,000 miles an hour, to be retained in its orbit by a cable attached to the pole of the sun, we will say, that cable would have to be of a strength sufficient to suspend a weight equal to 1,356,968,450,000,000,000 tons—a weight and strength transcending all human comprehension! Such is the tremendous power exerted by the sun upon our globe, without any visible connection, and at the distance of 95,000,000 of miles. Nor

does his power end here; Jupiter, Saturn, and Uranus, vastly larger spheres, and revolving at distances immensely greater, are bound and guided with equal firmness by this mysterious influence. And even Neptune, rolling onward its lonely way in the far and dim immensity of our system, at the distance of 2,862,000,000 of miles, is ruled by it in its appointed path, as regularly and certainly as Mercury that revolves forever within his blaze.

The sun is the only self-luminous orb in the whole system to which it belongs—*He is the light thereof.* The planets and satellites all shine by light borrowed from him; our own moon owes her silvery lustre to his radiations. The sun pours off light from his surface continually in all directions far into the depths of space; and its intensity, like that of gravitation, diminishes inversely as the squares of distances.

Two different theories have been proposed to explain the production of light. Newton, Laplace, and others, suppose light to consist of *luminous particles* darted from the surface of the sun in all directions; that these infinitely minute particles are influenced by the repelling and attracting forces of matter, and thus turned back or reflected from their surfaces in some cases, and absorbed into their interstitial spaces in others. But this theory has fallen rather into the back-ground, and another called the Undulatory Theory has been introduced, as accounting for certain phenomena more satisfactorily than the former. According to this, light

consists in the waves or vibrations excited by the sun, or other luminous bodies, in a medium called the Luminiferous Ether, which is supposed to fill all transparent bodies, and to extend to the remotest distances in space. Thus, according to one hypothesis, luminous particles are supposed actually to come from the sun to the earth; and according to the other, the sun only occasions a disturbance or waves in the ether, which extend with great rapidity. Whichever of these theories we adopt, inferences equally marvellous follow. According to the first, how wonderful, almost incredible, that innumerable myriads of material particles are launched through space from the sun, and from all luminous and reflecting bodies upon the earth, in all possible directions, yet without interference or producing the least confusion of vision. And according to the second, equally wonderful is it, that waves or undulations of the elastic ether are circling in all directions from ten thousand centres without being defaced or obliterated. Waves generated by fifty or a hundred pebbles scattered at one and the same time upon the bosom of the lake, would mutually oppose, cross, and break up one another into a mere confusion of ripples. And even vibrations in the atmosphere, produced by sounds or voices from scores of sources at once, become utterly undistinguishable to the acutest ear. Not so with the medium of vision; the radiant vehicles of light (whatever they be) are infallible in their progress —they ever carry and imprint the messages of the uni-

verse, great or small, with unfailing accuracy and distinctness.

Another remarkable fact connected with light is the inconceivable *velocity* with which it travels. This is no hypothesis merely, but a matter of observation. This has been ascertained by comparing the *calculated and actual time* of the eclipses of the satellites of Jupiter with the time at which they *appear to the eye*, when the earth was at the nearest and farthest points of its orbit from that planet. At the farthest point it was observed that they uniformly appeared 16′ 26.6″ later than at the nearest point; hence it appeared that light must have occupied this length of time in travelling across the earth's orbit, or 190,000,000 of miles. Hence the velocity of light is found to be 192,000 miles per second.

The sun's light presents us with another marvellous class of facts in the production of *colors*. It was long supposed that the sun's light was perfectly white; but passing a pencil of sunlight through a glass prism, it is found to be made up of all the colors in the rainbow —red, orange, yellow, green, blue, indigo, and violet. According to Newton's theory, pure light is a mixture of all these seven in certain proportions. If the red, for instance, is removed, then the mixture of all the others will be blue. If the blue is taken away, the mixture of the others will be yellow; and so of all the rest. Now the colors of all natural bodies, he tells us, "have no other origin than this, that they are variously

qualified to reflect one sort of light in greater plenty than others." Accordingly when the sun's white light falls upon the scarlet geranium, it absorbs the other six colors, and reflects to the eye only the red rays. When the light falls upon the blue flower, it throws back upon the vision the blue rays only, while it absorbs all the rest. When the sunbeams fall upon the petals of the pure white lily, they reflect all the rays. And when the light falls upon a black object, it absorbs all the rays, reflecting none of them.

The Undulatory Theory accounts for the various colors in a different way. This supposes the surfaces of objects to possess properties that impart different vibrations to the luminous ether. If a body sends back white light, unchanged in its vibrations, it appears white. If the surface has the property of altering the vibrations to that which is calculated to produce redness, the result is a red color; and so of all the others; while the annihilation of the undulations produces blackness. According to this theory, the rate and the length of the undulation determine the color, a different sensation being thereby produced upon the optic nerve. The analytical examination of this subject shows, that to produce *red color*, the ray of light must give 37,640 undulations in an inch, and 458,000,000,000,000 in a second. *Yellow* requires 44,000 in an inch, and 535,000,000,000,000 in a second. Blue requires 51,110 in an inch, and 622,000,000,000,000 in a second. "Such results are among the highest refine-

ments of science, and when contrasted with the most sublime efforts of the imagination appear immeasurably superior to them."

A sunbeam is a mysterious creation; science has proved that no substance can be exposed to it without undergoing a change. In it have been discovered, beside the properties that impart light and color, certain *dark rays*, by whose magic, though invisible pencil, can be delineated in a moment every scene of earth, and every form of life. This great secret, after long study and many experiments, having been wrested from the Lord of Day, the lover of nature may now, by this heliographic art, record her arrangements, copy her beauties, and delineate her most delicate features. By the agency of the very rays that give life and brilliancy to the laughing eye and blushing cheek, we can trace the outlines of the features we admire, and stamp on perennial leaves the hallowed scenes of family and home!

To the light of the sun belong many other interesting properties, such as those connected with its polarization, refraction and radiation; with animal and vegetable life; with heat and electricity; with magnetism and various other agencies of nature; of these our limits forbid us to speak in particular. But after all the protracted study, and endlessly varied experiments of the most gifted minds upon these various properties and laws of light, of the principle itself we know nothing. "The solar beam has been tortured through prismatic glasses and natural crystals. Every chemical agent

has been tried upon it, every electrical force in the most excited state brought to bear upon its operations, with a view to the discovery of the most refined of earthly agencies; but it has passed through every trial without revealing its secrets; and even the effects which it produces in its path are unexplained problems still to tax the intellect of man."*

Though ignorant of the essential nature of light, we well know that we are constantly partakers of a thousand benefits that flow from its great source. The rays of the sun are the ultimate cause of almost every motion which takes place on the surface of the earth. By its heat are produced all winds, and all those electrical disturbances we call thunder-storms, which purify the atmosphere we breathe. By its heat, also, the waters of the ocean ascend in vapors, travel through the air, descend in showers, irrigate the land, supply the springs, and form the rivers. By its vivifying action vegetables are enabled to draw their support from the soil and the air, to put forth their blossoms, to ripen their fruits, and to become, in their time, the support of man and beast. Through its illuminating power we enjoy the inestimable advantages, and receive all the undefinable pleasures of vision. Every animal, every plant, owns that life and health are due to its light, and all living things rejoice in its presence.

* Poetry of Science, p. 124.

REFLECTIONS.

From the creation true philosophy, as well as religion, ever leads us to the Creator; and nowhere is this transition of our thoughts easier or more natural than from the contemplation of the Greater Light. The vastness of his dimensions, the splendor of his aspect, the rotation of his majestic circumference, his potent attraction, the mighty forces in operation upon his surface, his awe-inspiring flames, and the mysterious but beneficent influences of his light—all present phenomena that at once amaze and overwhelm the mind! He who can, with any degree of intelligence, contemplate this glorious orb of day, and daily enjoy its benign and life-giving influences, and yet feel no sense of gratitude, no feeling of devotion awakened within his breast, surely can of right claim no higher place in the scale of animated beings than that of those "meaner things," that, "with brute unconscious gaze," wander among the works of God. Among all the visible objects of creation, there is none whose nature and functions are so wonderful—none whose glories are so much to be admired—none whose beneficent influences are so wide-spread, as the Sun; none where the eternal Power and Godhead are more clearly seen; none that more impressively call us to render unto the Lord the glory due unto his name.

In the Sun we have the most worthy *emblem* that the visible universe presents of HIM, who, with the word of

his power, kindled up its glories, and with the strength of his right hand established it in the heavens. And the analogies between the Sun of nature and the SUN OF RIGHTEOUSNESS are both striking and instructive.

In the opening scene of the fourth day we have a fine image of the advent of the Redeemer of men. On that morning the sun burst forth in its unveiled glories, irradiating the new-made earth, and revealing upon its face scenes of loveliness and grandeur which could neither be seen nor known before. So arose the Sun of Righteousness upon the world of mankind, an object as wonderful and as new in his person, and character, and office, as the great orb of day when it first came forth to run the circuit of the heavens—pouring a flood of light from above upon benighted humanity, and opening up to them views of truth, happiness and immortality, such as the world had never known or heard before; and, like the solar light, while revealing all else, remaining Himself a GLORIOUS MYSTERY.

As the natural Sun is the centre of the system of creation, so the Sun of Righteousness is the vital centre of revealed truth and religion. He is the heavenly orb that illumines and animates every page throughout the whole circle of Revelation; and to Him point from every quarter, like the rosy fingers of the morning, all the types and prophecies, all the doctrines and sacraments, as to their radiating focus. He is the light, the life, and the bond of union that constitute them into one gracious and harmonious whole.

MOON'S SURFACE.

As the sun shines by his own light, so the Son of God poured the light of truth upon men from the fountain of His own mind. The instructions he imparted were neither derived from tradition nor borrowed from philosophy. He was a self-luminous and Divine Orb, risen upon the darkness of the world, shedding new light, and revealing new truths to bewildered humanity.

As in the pure sunbeam we have combined all the colors of the rainbow in their due proportions, so in Christ we find all virtues and graces harmoniously blended in one perfect character. In Him we behold every principle, every affection, every impulse, in perfect equipoise.

As the sunlight, on whatever foulness or corruption it may fall, remains uncontaminated, so the Son of man, amid all the temptations, guilt and depravity of earth, continued pure and unspotted. From every company and from every scene He emerged sinless and immaculate; and re-entered the portals of heaven pure as when He left the bosom of the Father.

As the light of the sun is unlimited and inexhaustible, so also are the healing and saving beams of the Sun of Righteousness. As a thousand eyes turned toward the natural sun, at the same instant, are as fully and perfectly enlightened as if but a solitary eye beheld it; so if a thousand, or a thousand millions of perishing sinners look to the Almighty Saviour, in one moment, He is infinitely sufficient to hear and save them all. His power to save

"Lives through all life, extends through all extent,
Spreads undivided, operates unspent."

As the sun's law of gravitation extends over the whole solar system, so the *Law of love*, proceeding from the Sun of Righteousness, extends its authority over the whole family of man. Gravitation exercises its dominion alike over the mightiest planet and the minutest asteroid; so the Divine law of love, with equal hand, imposes its obligations upon kings, and peasants and beggars; its authority is no less binding in courts and cabinets than in churches and families; its voice is to be heeded no less by the diplomatist sent to foreign realms, than by the preacher who remains among his flock at home. To all it speaks alike, in the name and in the words of its Divine Original, "Love one another, as I have loved you."

THE MOON.

And God made the Lesser Light to rule the night.

The moon is our nearest neighbor in the heavens, and is, in fact, an appendage of our world. In herself she is a perfectly dark sphere, like that upon which we tread. She shines by borrowed light, and becomes visible simply by the rays of the sun falling upon her disk, which, according to the ordinance of the fourth day, she reflects to enlighten the earth. The sun always illumines one-half of her surface; but that en-

lightened side is so situated at different points of her orbit, that we see only a less or greater part of it; and hence arises her ever-varying aspect.

The moon is one of those heavenly bodies which astronomers call *satellites*, or secondary planets, and revolves around the earth as a centre, accompanying it at the same time in its annual course round the sun. The moon completes her circuit round the earth in 27 ds. 7 hrs. 43 min. 11 sec.; but while she has been accomplishing it, the earth has been moving uniformly on in her annual path, at the rate of 68,000 miles per hour; and to overtake her, so as to appear precisely at the same point in the heavens as she did at the commencement of her circuit, she has to travel on for 2 ds. 5 hrs. 52 sec. longer. So that what is called a lunar month, or the time from one new moon to another, is 29 ds. 12 hrs. 44 min. 3 sec.

While the moon thus revolves round the earth, she also rotates on her axis in precisely the same period; and by this arrangement she keeps the same side of her sphere always towards the earth. This may be easily explained. Let a lamp standing in the centre of a circular table represent the earth, and let a person move once round the table, always directly facing the lamp, and he will find that, in going round, he has faced every point of the compass, or made a complete rotation on his axis, while his face, like the moon's, has been all the while toward the lamp.

Thus the moon is found to have a triple motion, be-

sides certain other oscillations of too abstruse a nature to be introduced here, which altogether render her annual career a most wonderful and complicated gyration indeed. And yet she has been thus pursuing her appointed rounds from year to year, and from century to century, fulfilling her commission as the Ruler of the Night, without failure or faltering, ever since the morning of time.

Moving in an elliptical orbit, like all the other celestial spheres, the moon is sometimes nearer and sometimes further; her mean distance from the earth is 238,793 miles. This separates her from us by a vast interval, it is true; yet a hundred cables, such as that of the Atlantic Telegraph, if spliced together, would reach from the earth to the moon.

The moon's diameter is 2,160 miles, consequently her bulk is only one-forty-fifth part that of the earth. The difference in size between the two globes, therefore, is great. Were a traveller to start at mid-day, and move along the equator of the moon at the rate of ten miles an hour, he would keep the sun at his noon point over his head while he went completely round her, which he would accomplish in about four weeks. To perform the same feat on our globe he would have to travel at a rate of more than 1,000 miles an hour.

The optical instruments of the present day have brought the moon near enough to be surveyed with great accuracy and satisfaction. Looking through the

great Rosse telescope, "the eye is directed to the heavens, having a pupil of six feet diameter, with the most complete optical structure; and thus the quantity of light which the eye receives from any point of the heavens is augmented, it may be, 50,000 times. The rising moon is seen from the observatory with the same increase of size and light, as if her solid globe, 2,000 miles in diameter, retaining all its illumination, really rested upon the summits of the Alps to be gazed at by the naked eye." Scientific ingenuity has gone further. Two independent photographs of the moon, taken at a certain epoch in two different lunations, have been successfully obtained; which, when placed in the magic stereoscope, present her to the eye in her true spherical form, with her physical features standing out in all their actual reality. "Nothing," says Sir John Herschell, "can surpass the impression of real corporeal form thus conveyed by these pictures, the production of which is one of the most remarkable and unexpected triumphs of scientific art."

When viewed through a powerful telescope, the moon presents a scenery of plains and mountains, peaks and caverns, hanging precipices, and insulated rocks over her whole extent. No seas, or any certain indications of water in any form, have been discovered on her surface. Many of her plains are of a peculiar character, being surrounded by a circular ridge of mountains, like a wall or rampart. Out of the midst of many of these walled-in plains spring isolated and

precipitous mountains, like tapering obelisks, reaching a height in some instances of several miles, and throwing a shadow on the side opposite the sun, which may be as distinctly seen as the shadow of a house in the street. Another singular feature of the moon's surface consists in vast circular cavities of all dimensions up to one hundred miles in diameter, and down to three miles in depth. These abound everywhere—surmounting the highest mountains, piercing the deepest valleys, and checkering the monotony of the plains. The mountains of our satellite are not only very numerous, but many of them also very lofty, much more so in proportion to its size than the mountains of the earth. The highest of the lunar mountains reaches an elevation of 26,691 feet.

The surface of the moon has been accurately mapped, and to its principal plains and mountains have been given names as to those of our own globe. And in order to gain a clearer idea of lunar scenery, let us now survey one or two of these a little more closely. Among the more notable of her mountains is one that has received the name Tycho. "Let us in imagination stand for a few moments within its arena. Around us on every side rises a mighty wall of rock, forming a circle of fifty-four miles diameter. Looking up from the interior plain, it is 17,000 feet of clear precipice before the eye rests. Before us extends a plain for about twenty-five miles, interrupted, however, by concentric ridges of rocky mountains or barriers, that en-

circle in irregular and broken masses of fearful magnitude and height the awful centre, whence, from a black and profound gulf, that opens its mighty jaws, springs a huge dark mountain, whose steep and pointed summit, higher than the lofty Snowdon, shoots upward for above 4,000 feet in sheer precipice from the plain. The centre, this, of a terrible convulsion that once shook the very heart and substance of our satellite."*

Let us look at another of these annular mountains—Eratosthenes. At the extremity of a remarkable range is a vast crater, thirty-seven miles in diameter; the interior of this is almost as even and uniform as a regularly laid stone wall; the bottom is a plain, which, however, is not on a level with the general surface outside, but lies 3,000 feet below it. The edge of the crater being raised 3,000 feet above the exterior surface, it follows, therefore, that the interior descent is 6,000 feet. From the centre of this awful pit rises a stupendous cone-like mountain, full 10,000 feet above the edge of the crater, making its entire altitude 16,000 feet; so that its summit is brightly lighted by the sunbeams long before its base, or any portion of the surrounding plain, has received a ray.

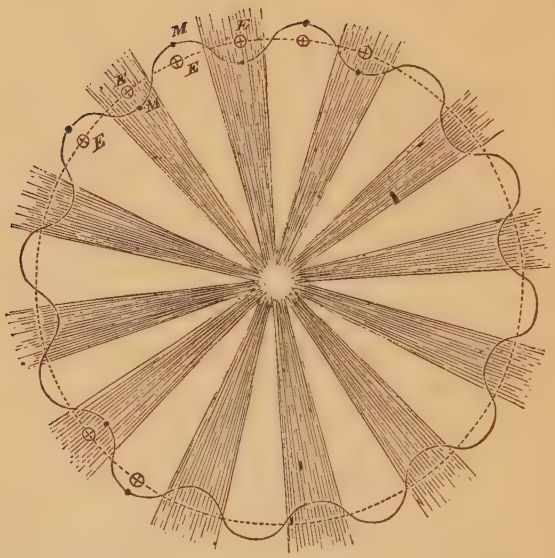
The moon has her plains as well as mountains. In the northeast quarter of her hemisphere is a plain called Mare Imbrium, or Sea of Showers, though no shower has ever fallen upon it. Making *thought* our chariot, let us take our flight and visit it, taking with

* Crampton.

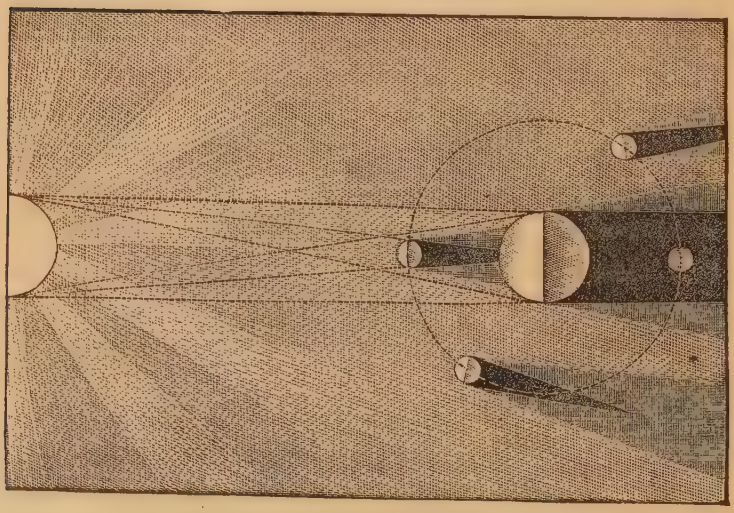
us Mr. Crampton for our guide. "Casting our eyes around us, what do we see? A boundless desert, stretching away as far as the eye can reach on every side, save in one or two points, where a chain of lofty mountains can be perceived, whose brilliant pointed summits, glittering in the sunbeams, just appear on the distant horizon. The light and heat are of a tropical fierceness, and there is not a cloud afloat to shield us. An infinite number of circular pits of all depths and diameters are scattered over the plain. Above, the sky is black, out of which the sun gleams like a red-hot ball; and the stars sparkle like diamonds, for no atmosphere such as ours exists, to give by its refractive and reflecting powers the delicious blue to its heavens, and the softened shade to its landscape. The lights and shades are indented upon its features deep and dark, or intensely bright; no softening away in the distance; no gentle and beautiful perspective; no lovely twilight morning or evening stealing over or away from the scene. All the shadows are abrupt and sudden; all the outlines sharp, clear; objects appearing startlingly near even when really distant. No sound follows our foot-fall, or is ever heard in that silent place, for there is no atmosphere to conduct it; no fresh breeze blows on its mountain tops, sighs through its burning deserts, rustles through the brilliant green of forests, or waves over grassy meadows; the silence of death broods over its arid wastes and rocky shores, against which no tides or billows break."

The seasons and climate of the moon are peculiar. Whatever of summer and winter she may have, must result from her rotation on her axis, the period of which is only a short month. Hence the length of her day is equal to fifteen of our days, and her night is the same; consequently, she has but twelve days and twelve nights in the year. To relieve her tedious nights she enjoys a splendid moonlight, the earth performing exactly the same office, and exhibiting a similar change of phases, only being thirteen times larger to her, that she does to us. No indications of an atmosphere have been detected about her; if she has any, it must be one of extreme tenuity, for it is demonstrable that its density cannot be equal to a two-thousandth part of that of the earth. "Hence the climate of the moon," says Sir John Herschell, "must be very extraordinary; the alternation being that of unmitigated and burning sunshine fiercer than an equatorial noon, continued for a whole fortnight; and the keenest severity of frost, far exceeding that of our polar winters, for an equal time."

The moon presents us with another interesting class of phenomena in the eclipses which she sometimes occasions to the sun, and sometimes undergoes herself. An eclipse of the sun is caused by the moon in her revolution round the earth coming between us and the sun, and being a dark body, she appears as a black spot on the sun's surface, covering a less or greater portion, or even in some conjunctures, the whole of his disk.



MOON'S ANNUAL PATH.



ECLIPSES OF THE SUN AND MOON.

An eclipse of the sun can take place only at the time of the new moon. The shadow of the moon, which on such occasions falls upon the earth, covers only a small portion of its surface, not being at any time more than one hundred and eighty miles in diameter. This shadow travels the surface of our globe at the rate of 2,200 miles per hour; so that the sun is never totally obscured, at any particular point, for more than four minutes.

An eclipse of the moon is produced by the interposition of the earth between her and the sun. The earth being a dark globe, and enlightened by the sun, casts a shadow in the form of a cone on the opposite side, which reaches to the distance of 840,000 miles, or three and a half times the distance of the moon's orbit; and when the moon happens to pass through this shadow, she is deprived of the sun's light, and eclipsed. This can take place only at the full moon. And as this shadow is about 6,000 miles broad at the distance of the moon, her passage through it, when central, occupies from beginning to end about 3 hrs. and 45 min.—All eclipses both of the sun and moon recur within a period of eighteen years and ten days.

Solar and lunar eclipses, while presenting striking exhibitions of the workings of the celestial machinery, are also occurrences of great advantage and utility. They plainly show us that the moon is an opaque body —that when we cannot see her she really exists—that when we behold her only as a slender crescent the

whole globular body is there—that the earth is of a spherical figure, as its shadow falling on the face of the moon is always circular—that the sun is larger than the earth, and the earth larger than the moon. Lunar eclipses are also of importance to determine with accuracy the longitude of particular places on the face of the earth.

Eclipses have also served to establish the dates of many events recorded in ancient history. The occurrence and character of an eclipse, together with the locality at which it was observed, in connection with any memorable event of antiquity, being given, the astronomer by calculating backwards, can read off by the clock-works of the universe the precise time when the event took place. The celebrated eclipse mentioned by Herodotus, which, by its ominous appearance, caused the suspension of the battle between the Medes and Lydians, followed by a treaty of peace, has been ascertained to have occurred in the 585th year B. C.; and not only that, but the course of the moon's shadow over the earth's surface, being also traced by the same calculation, determined the field of the impending conflict to have been at the mouth of the river Halys. Another eclipse mentioned by Thucydides, as having occurred on the afternoon of a summer's day, in the first year of the Peloponesian war, is found to have happened, August 3d, B. C. 413, and to have passed over the city of Athens. Xenophon relates that during the siege of Larissa, an eclipse of the sun took place,

which produced a panic among its Median defenders, of which the Persians took advantage and captured the city; and astronomical calculation has fixed the event on the 15th of August, B. C. 310; and that the shadow being on this occasion only twenty-five miles in diameter passed centrally over the place.

Two blocks of stone were recently exhumed from the ruins of Nineveh, and brought to the British Museum; one containing a list of kings of Assyria, and the other a list of dates; but there was no known connection between them. Rawlinson, the great decipherer, however, has put the two together, and found, in fact, that they are complementary parts of the same stone, fitting into each other exactly, and giving thus a complete and exact record of the Assyrian empire for a period of two hundred and forty-three years. Among the facts recorded on these stones is an *eclipse of the sun*, which is distinctly and with particulars noted. And astronomical calculations have just ascertained that it occurred on the 15th day of June, B. C. 763, and that it was a total eclipse.—Thus the sun and moon, the faithful witnesses established in the heavens, point out to us the places, and read to us the dates, of events that transpired in this lower world hundreds and thousands of years before we came into being! How wonderful the ingenuity of man that can elicit such information from distant worlds; how surpassing wonder the undeviating and infallible movements of those heavenly orbs through all the lapse of ages!

REFLECTIONS.

In the moon we have literally opened up to us *a new world*, full of strange scenes, and suggestive of a thousand thoughts that expand our conceptions of the great work of creation. Who can look up at her in her naked grandeur, or contemplate her scenes of frightful wilds and desolations, or witness the ominous gloom attendant upon her eclipses, and not be led to muse, Whence originated this wondrous orb? Who poised it in the empty space above? When were those rocky steeps, those mountain pinnacles, piled on high? By what means, and for what ends, were scooped out those profound and gloomy caverns in her sides? Whence the impulse that gave to her her mystic motions through the heavens? Who were present and witnesses of the deed? What has been her eventful history? And to what destiny does she hasten in the end? These are reflections in which no serious mind can indulge without being raised in awe and adoration to the Great Architect, who by his Spirit garnished the heavens, and established the earth.

From a hint dropped in the Holy Book, the moon occurs to us at once as an expressive emblem of the Church of God on earth.

As the moon, though widely separated from the earth, is attached to it by the invisible bonds of gravitation, and ordained to travel with it in its appointed course round the sun—so the church militant, though

distinct from the world, is connected with it by many ties, and appointed to pursue her pilgrimage along with it to eternity.

As the moon receives all her light from the natural sun, so the church receives all her spiritual light from the Sun of Righteousness. Let the sun veil himself from the moon and she is in utter darkness, and can be seen no more: so let the Sun of Righteousness hide his face from the church and she is involved in darkness and sorrow; her light, like that of the moon, is derived from another and a higher source.

As the moon has been appointed to reflect the light she receives upon the earth to relieve her darkness, to guide the lone mariner on the deep, to lead the belated traveller in his path, and to cheer the shepherd keeping watch over his flock by night—so the church has been ordained to reflect her heavenly light for the guidance of benighted and bewildered humanity around her. The design of her establishment, like that of the moon, is to give light upon the earth.

As the moon remains not stationary in the heavens over some favored spot, but according to the law of her creation, pursues her career round the globe to cheer and enlighten its every habitable region—so the church has been organized and commanded to carry the light of the Gospel into all the world, and preach the unsearchable riches of Christ to every creature.

As the moon, while shining in her usual brightness, moves forward unnoticed, but when under an eclipse

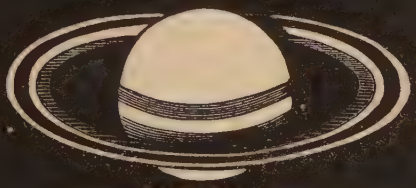
has the gaze and remarks of half the earth's population —so the church while walking in light and love, enlists but little of the world's attention; but let her honor pass under a cloud, or her purity be tarnished by the misconduct of but a member, and the eyes of all are fixed upon her, and her failing repeated by every tongue. Let the Israel of God take heed to their ways.

THE PLANETS.

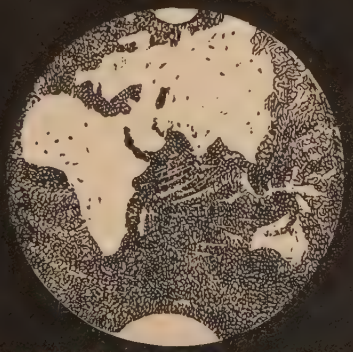
He made the Stars also.

The inspired Historian, having spoken of the two great lights, and described their appointed offices so far as we are concerned, before returning to the creative process on the face of the earth, casts a glance toward the nocturnal heavens, and tells us that the same Almighty Hand "made the stars also." Looking upward with him, the first thing that strikes us, is the great number and brilliancy of these stars. Observing them closely, other features and distinctions soon reveal themselves to us among them. They appear to be of two kinds or classes. One class, by far the most numerous, retain the same relative positions, never further from or nearer to one another; and are of such a nature that no telescope, however we may increase its magnifying power, produces the least change in their apparent dimensions: these are called Fixed Stars. The other class, few in number, continually change their positions,

MARS.



SATURN.



THE EARTH VIEWED AS A PLANET.

sometimes approaching to and sometimes receding from each other; now rising or setting early, and now late; these are readily magnified by the power of the telescope, and are called Planets, or wandering stars. Of planets there are eight large ones, our globe being included in the number; and about one hundred small ones, or planetoids. All the planets, at different distances and in different periods, revolve around the sun as their common centre; and their orbits, magnitudes, and rotations have been calculated with the utmost precision.

The first and nearest planet to the sun is MERCURY. It revolves around him at the mean distance of 37,000,000 of miles, and completes its circuit in 87 ds. 23 hrs. and 25 min.; in doing this it moves at the amazing velocity of 109,000 miles per hour. It rotates upon its axis in 24 hrs. and 5 min. Hence, while its days and nights do not differ materially from our own, its annual changes of summer and winter return four times to our one. Its diameter is 3,200 miles; consequently its bulk is only one-fifteenth that of our globe. But it is composed of materials far more dense or weighty than those of any of the other planets. Its entire weight is but one-sixth that of the earth; and gravitation at its surface is only two-fifths of what we experience; hence an individual who can lift 200 pounds on the earth, could lift on Mercury 500 pounds with the same exertion.

This planet, moving as it does so near the sun, is

visible to the naked eye only at intervals, or when furthest from him, when it appears to emit very white light. In consequence of its orbit being within that of the earth, it passes in the course of its revolution through all the phases of the moon, which proves it to be in itself a dark body, and this is also proved from its transit across the sun, when it appears as a black spot on his disk. By reason of its constant proximity to the sun, never further than twenty-nine degrees, the telescope has been able to make but few discoveries on its surface. Certain inequalities, however, have been detected; some of which are supposed to be mountains. The quantity of light and heat poured by the sun on mercury is nearly seven times that upon the earth; but as it is surrounded by an atmosphere much loaded with clouds, these may serve to mitigate the intensity of both, so that it is possible this planet may be as comfortable an abode as our own globe.

The next planet in order is VENUS, the morning and evening star, and, to the naked eye, the most brilliant and beautiful in the heavens. It revolves about the sun at the mean distance of 68,000,000 of miles, moving at the rate of 80,000 miles per hour, and completing its circuit in 224 ds. and 16 hrs. Hence the length of its year is only seven and one-half months. It rotates upon its axis in 23 hrs. and 21 min., so that its days and nights, as to length, are very nearly the same as our own. In its revolution around the sun, like Mercury, and for the same reason, it passes through all

the phases of the moon; and like that planet also, it makes a transit across the sun's disk; both these circumstances prove it, though shining so brilliantly, to be in itself a perfectly dark body. Its next transit will be on December 9, 1874.

In size and weight this planet is very nearly equal to the earth; its diameter being 7,800 miles. From its surface, the sun appears twice as large as he does to us, and of course it receives double the amount of light and heat. Both these, however, may be greatly modified by its extensive and vaporous atmosphere, which is said to be as dense again as ours; so that its climate may be genial and delightful as that of the tropical regions of the earth. Venus, at its nearest approach, comes within 27,000,000 of miles of the earth. It might, therefore, be supposed that we should be better acquainted with it than any other celestial body, as no other comes so near us, the moon excepted. This, however, is not the case; its intense lustre dazzles the sight, and renders it the most difficult of all to define with the telescope. Some observers have thought they detected several mountain ridges of great extent and elevation upon its surface, but this is doubtful.

The third planet in the system is the EARTH, the world of man. We have already described the physical phenomena of the earth's surface, and it remains for us here only to notice her position and relations as a planet, or a member of the solar system.

The earth travels round the sun in an elliptical

orbit, the longer diameter of which is more than 3,000,000 of miles greater than the shorter; and, in consequence of this, strange as it may seem, we are much nearer the sun at midwinter than in midsummer. The mean distance of our globe from the sun is about 92,000,000 of miles. It accomplishes its annual revolution, a journey of more than 550,000,000 of miles, in 365 ds. 5 hrs. 48 min. and 49 sec. And nothing can be more astonishing than the uniformity and precision with which it performs this stupendous circuit. To assist us in appreciating this, let us suppose that the solar system was first set in motion just 6,000 years ago, and that the earth had fallen behind or been in advance of its designed and appointed speed only *five seconds* in running 1,000,000 of miles, which would have been a small error indeed; yet, at *this date*, it would have amounted to more than six months, and our globe would have been at that point in her orbit marked by the first of January, when it should have been at that of the first of July. But no such reversion of seasons has taken place, therefore even this discrepancy has not occurred; so that midsummer and midwinter are to us where they were to Noah in building the ark, and to Adam when roaming amid the beauties of Paradise.

It is a fact worthy of special notice and admiration, that the length of the earth's year has been so measured as to be exactly adapted to the constitution of the plants and animals occupying its surface, or the

constitution of these plants and animals has been so adjusted as to be exactly suited to the length of the year. The vegetable clock, says Wheewell, is so set as to go a year. To raise the sap, form the juices, unfold the leaves, expand the flowers, mature the seed, ripen the fruit, and rest and recuperate the vital energies —all this requires just the present seasons, and just the period of a year. Were the year either lengthened or shortened three or four months, the whole vegetable world would be thrown into utter disorder; the functions of plants would be entirely deranged, and the whole vegetable kingdom would be involved in immediate decay and rapid extinction. The same holds true in regard to animals. Every species of beasts in all their reproductive energies, functions, and habits are constituted with obvious reference to the yearly cycle. So, too, are the birds; the process of pairing nesting, hatching, fledging, etc., take up and require the year to complete. And even the insects in their production, transformations, and hybernation, evince a similar adaptation to this specific period of time. Here, then, is an adjustment, not in one or two species only, but in thousands and tens of thousands, that offers a most striking demonstration of calculating and designing wisdom in the formation of the world. Here are myriads of animal and vegetable chronometers, endlessly diversified in form and character, yet all wound up so as to run exactly for the period measured out by the earth's revolution.

While the earth pursues its yearly course, it at the same time rotates upon its axis, or a line of diameter. This axis is not upright, or perpendicular to the plane of its orbit, but inclines twenty-three and a half degrees from a perpendicular line. This inclination it preserves throughout its annual course, always pointing in the same direction, always keeping parallel with itself. From this simple adjustment a series of changes and influences result of the utmost importance to our world. By this means the whole round of the seasons is produced, and the duration of light and darkness made to vary, not only at different periods of the year, but also in all the different latitudes of the globe. It is owing to this that, during the summer half of the year, the days increase in length as we depart from the equator, from twelve hours until, at the pole, there is a continuous day of sunlight for six months; while in the opposite hemisphere there is a similar increase of darkness, until, at the other pole, there is a night of six months, during which the sun never once appears above the horizon. Had the earth revolved in a circular orbit and been set to rotate on a perpendicular axis, (which probably would have been the arrangement of man,) we should have known none of these interesting and important vicissitudes. Day and night would have been always and everywhere of the same uniform length; and instead of the delightful diversity of seasons which we now enjoy—the winter reposing and invigorating the energies of vegetable and animal, the

spring renewing and enlivening the face of nature, the summer investing the earth with its luxuriance and glories of sunshine, and autumn bringing in its golden fruits and softly fading shades—instead of all this, the year, from its beginning to its close, would have been one dull monotony. All these grateful, interesting, and important changes are secured by the introduction of an angle of few degrees—by the slight inclination of a single line! How simple the means, yet how vast and varied and important the results!

The civil day of twenty-four hours is not the measure of the earth's diurnal revolution, but a *mean* of all the solar days in the year, which are perpetually varying. The exact time in which it rotates upon its axis is 23 hrs. 56 min. 4.09 sec. This carries its equator round at the rate of more than 1,000 miles per hour—a velocity in itself sufficient to rend the mountains, yet so equable is the motion that it disturbs not even the delicate down that rests so lightly upon the leaf of a flower! It is, moreover, an absolutely undeviating and perfect motion. Our globe in its diurnal rotation has not varied the breadth of a hair or the fraction of a second since man was placed upon it. If its motion upon its axis had slackened by the one-hundredth part of a second in a revolution, and continued to do so for 6,000 years, the day would have been already lengthened by six hours, and the number of days in the year reduced to 292. But as no such change in our days has occurred, of course no

such variation even as the hundredth part of a second has taken place. Who then can sufficiently admire the perfection of the Creator's works! But our admiration must rise to the higher feeling of devout gratitude when we consider that this perfection of the earth's rotation is essential to the welfare of every living thing upon it.

In the constitution of both plants and animals there is found a periodicity of functions corresponding to the period of the globe's diurnal rotation, the one being exactly adapted to the other. The cycle of light and darkness, says Wheewell, from whom these thoughts are borrowed, coincides with the cycle of the animal and vegetable constitution. The chemistry of all plants is carried on according to the regular alternation of day and night, which also have their influence on the circulation of the sap. Flowers, too, have their set and regular hours to open and close. All these and many other things clearly prove that there is a diurnal period belonging to the constitution of vegetables, and that they are in their structure adapted to the periods of day and night. Animals also exhibit with equal plainness the same periodicity and adaptation in their constitution by their instinctive and stated habits of waking, sleeping, eating, etc. Birds retire and rise, and cocks crow through the watches of the night with the regularity of a clock. Nor is man in this case an exception; his food, and labor, and repose must recur with every twenty-four hours; any material or prolonged departure from this cycle will surely bring

on its retribution of evil in the loss of health and strength.

Now there appears no reason why the earth, of necessity, should rotate in just the period of twenty-four hours. It might have revolved in a very different period; other planets do so. Nor, on the other hand, can we discover any reason necessitating the constitution of plants, animals, and man to be just of the same periodical character; for aught that we can see, they might have been made for a period much longer or shorter, or all of them made for different periods. Whence then this universal harmony out of innumerable possibilities? Whence these equal periods in a bird and a planet, in a flower and a world, in a puny man and a stupendous globe? Whence this adaptation of every organized being of the earth to the specific time of its revolution on its axis? But one answer can be returned. But to perceive this point in its full force, let us for a moment suppose things to be otherwise than we find them; let us conceive the animal and vegetable machinery to be made to run for twelve hours, and the earth's rotation to be changed to forty-eight hours. What in that case would be the results? Obviously a total derangement of the whole organized creation; all the functions of both plantal and animal life would be fatally disturbed; both would languish and fail; and man himself would soon sink exhausted beneath the protracted toil of so long a day. How manifest, then, the fore-

sight and designing wisdom of the Creator in the existing arrangements of our world. How plain that he who measured out the impulse that gave to the earth its rotation, measured also the degree of vital energy that would adapt the constitution of every plant and animal that were to occupy its surface.

Equally manifest is the wisdom of the Divine Architect in fixing the *distance* at which our globe revolves around the sun. The distance of a planet from the sun, other things being equal, determines its amount of light and heat. If, therefore, the earth with its occupants, *as now constituted*, were placed much nearer the sun, or much further from him, the change would be attended with fatal consequences. Were it transferred, for example, to move in the orbit of Mercury, our light and heat would be increased seven-fold, and the dazzling splendor of the sun would extinguish our vision, and the intensity of his beams speedily dry up all the fluids in our bodies. On the other hand, were the earth driven away to revolve in the distant orbit of Saturn, our light and heat would be only one-ninetieth part of what we now enjoy, and the feeble and scattered rays of the sun, would scarcely enable us to distinguish him from a star; nay, ere we could cast about to make such an observation, the immeasurable cold would transform us into a rock of ice. We see, then, that our globe might have moved at a hundred different distances all too near the sun, and at a thousand other distances all too far from him, to be a suitable abode for its present

inhabitants. But we find it placed in an orbit where the temperature is exactly adapted to the bodily constitution, and the degree of light precisely suits the visual organs, of all its living tenants. To whom then are we to ascribe this striking coincidence, this happy and universal adaptation? To chance? or to the foresight and contrivance of the Infinite Mind?

Once more: The all-comprehending wisdom of the Divine Builder is seen in the *mass and dimensions* of our planet. The earth is a globe whose equatorial diameter is 7,926 miles; and whose density is four and a half times that of water; that is, the earth if placed in a balance would weigh four and a half globes of water of equal size with itself. These two things, its density and dimensions, determine the amount of gravitation at its surface; or which is the same thing, the force or weight with which any object or substance presses down towards its centre. Now the gravitation of the earth, for anything that appears, might have been different from what it is; it might have been much greater by increasing its size, or by employing denser materials, like those of Mercury, in its construction; or it might have been much less by reducing its dimensions, or by constructing it of lighter substances, similar to those of Saturn. Man's science can discover no necessitating reason why the globe should be precisely of its present mass or dimensions; we see in the system other planets that differ widely from it in both these particulars; gravitation on the surface of

Jupiter is two and a half times that of the earth; while on the surface of Mars it is only one-half what we experience. The gravitation of our globe, therefore, might have been much more, or much less than it is.

Let us now, for illustration's sake, consider what would be the consequences to the present vegetation and animals of the earth were its gravitation increased —say *doubled*. This, of course, would double the weight of every object and element on its face. The atmosphere would press with two-fold force, and thus render respiration laborious and painful. Water would be of double weight, and the sap in trees and plants would fail to ascend, so that every green thing would soon perish from the earth. Tools and implements would become unwieldy, and every mechanical operation in the field and in the workshop would demand as much strength again as at present. And in such a state of things, every animal would move about as if loaded with another of equal weight with itself. The operations of life would become impracticable, men would be barely able to crawl about, and their strength would be exhausted in bearing their own weight. The horse would be deprived of his power to labor, and of his speed to travel. The dog would lose his fleetness, the cat her elasticity and spring, and the bird its ability to glide through the air. Wheat and other grains would bend and break the straw, and be lost on the ground. Dwellings would fall by their

own weight. Rain and hail would beat down with increased force, and floods would rush with irresistible impetuosity. Winds would move with destructive power, and in stormy weather, neither house nor tree could resist their violence. In short, the whole course of nature would be overturned, all human labor and enterprise would be arrested, and all business brought to an eternal close.

If, on the other hand, we suppose gravitation to be diminished—let us imagine to *one-half* its present force; and consequences equally disastrous would result. Everything in this case would be half its present weight. The air would be two-fold lighter, and so become too rarified to sustain life. The sap would ascend with unnatural rapidity, and overload the leaves, and thus produce disorder and death throughout the vegetable world. Houses would rest so lightly on their foundations as to be turned over by every gust of wind like empty boxes. Things would hardly remain where we placed them, but would slide hither and thither with the slightest touch. Men and animals would move about with the unsteadiness of ships without ballast, and breathe with the distress experienced by travellers on the summits of the Andes. How different from either of these suppositions is the actual state of things, where we behold every thing throughout the field of nature, in due and suitable proportion, every thing adjusted and balanced to accomplish its purpose with ease and certainty; and

man and beast and bird adapted in the strength of their muscles and organs to every element about them, and all resulting in a world of pleasing activity and universal harmony!

We have now seen the most marked evidences of designing wisdom in the creation of the planet upon which we dwell—in the uniformity and perfection of its movements—in the adjustment of its annual and diurnal revolutions to the constitution of plants and animals—in the pleasing succession of seasons, and the variation of days and nights—in the distance at which it has been set to revolve around the sun, so as to measure for us the right degree of light and heat—and in its mass and dimensions graduating its attractive force to our strength and convenience. Who that intelligently views and duly weighs all these things, but must confess that the world we live in is the production of infinite Wisdom, Power and Goodness? "Thou, Lord, in the beginning didst lay the foundations of the earth; and the heavens are the work of thy hands. Thou hast made the beast of the field, and the fowls of the air, and every thing that creepeth upon the earth."

Leaving our own globe for the present, and continuing our outward progress from the sun, we next alight upon ruddy MARS. This planet, although at its nearest approach to the earth, 50,000,000 miles distant, yet is more favorable for observation than any of the others; and we are, therefore, better acquainted with

its physical peculiarities. In very many particulars, it bears a striking resemblance to the globe upon which we live. Its mean distance from the sun is 145,000,000 of miles; its orbit is quite elliptical, in which it moves at the rate of 54,000 miles per hour, and completes its revolution in 687 days; consequently its year and its seasons are nearly twice the length of ours. The period of its diurnal rotation is 24 hrs. and 37 min.; its axis, like the earth's, is inclined; hence it has days and nights of variable length, together with a diversity of seasons similar to what we enjoy. Its diameter is 4,100 miles. Both in bulk and weight, it is about one-seventh those of the earth. Its light and heat from the sun are about one-half of ours. It is encompassed by a dense atmosphere, that often abounds with clouds exhibiting all the various tints and shades of our own skies.

In its surface arrangements, also, this planet presents a marked similarity to the earth. In Mars, says Sir John Herschell, we frequently discern with perfect distinctness the outlines of what may be continents and seas. The land is of a ruddy color, while the waters appear greenish; both these, with their gulfs and promontories and islands, when its atmosphere is clear of clouds, are brought successively into view so plainly by the rotation of the planet, that it has been found possible to construct a chart of its surface. The shores are observed to be remarkably sinuous in their course, so that the indentation of the coasts by bays

and creeks is very picturesque. As this planet has no moon, its oceans probably are nearly tideless. Though no elevated mountain ranges have been discovered, yet the land is sufficiently mottled with shaded spots, to indicate an agreeable undulation and diversity of surface. Unlike our globe, its face is pretty nearly equally divided between land and water. Its heavy clouds are sufficient evidences of the formation and fall of rain to refresh its valleys and plains; while the pure white expanse which has been observed around the poles, offers a high probability that those regions are mantled with snow. These white patches gradually disappear as they become exposed to the returning sun of summer, and are greatest in extent when just emerging from the long night of their polar winter. These changes of appearance have long been observed to return as regularly as the seasons. Owing to the great eccentricity of this planet, being at one point of its orbit 27,000,000 of miles nearer to the sun than at the opposite point, the summers are hotter and the winters are colder in its southern hemisphere than in its northern. And this is confirmed by observation; for while the northern expanse of snow varies but slightly in dimensions, the southern is of great size in the winter, and almost vanishes in the summer. Thus, then, Mars has its sea and land, its atmosphere and changes of weather, its snows and rains and winds, its cloudy days and bright and sunny skies; and, if not its seed-time and harvest, it has at least its spring

and summer, autumn and winter, with all their pleasant vicissitudes, like the planet upon which our own lot has been cast.

Pursuing our outward course through the system, we next encounter a group of small planets, called ASTEROIDS, numbering about one hundred. All these revolve at different distances and in different periods, between the orbits of Mars and Jupiter. The diameter of the largest is only a little over 2,000 miles; and from this they descend to mere globules of fifty or forty miles in diameter. A man placed on one of these small worlds would spring with ease sixty or seventy feet high, and sustain no greater shock in his descent than he does on the earth from leaping a yard. On account of their diminutive sizes, but little is known of them.

Taking our leave with this brief and imperfect acquaintance with the planetoidal family, we have now, after leaving the last of them, to travel the mighty interval of 170,000,000 of miles, to reach the next great orb in the system, which is JUPITER. This magnificent planet, attended by four satellites, sweeps round the sun at the distance of 495,000,000 of miles, moving at the rate of 29,000 miles per hour, and accomplishing its revolution in 4,332½ days, a period of nearly twelve years. Its dimensions are upon a scale of equal grandeur; its diameter being not less than 87,000 miles, and its bulk more than 1,300 times that of the earth. It is composed of lighter materials, how-

ever; but on account of its surpassing magnitude, is of a weight 333 times that of our globe. This is the largest body connected with the planetary system, the sun only excepted. When nearest the earth it is 400,000,000 of miles distant from us; yet, after Venus, it is the most brilliant star in the heavens. This stupendous sphere rotates upon its axis, which is very nearly perpendicular, in 9 hrs. and 56 min.; thus carrying round whatever beings or objects may be on its equator, at the rate of 28,000 miles an hour, or twenty-seven times more rapidly than are those on the equator of the earth. Hence, Jupiter has a rapid alternation of days and nights, varying but little if any in length; and a slow round of seasons, each season nearly three years long, and varying as little in their temperature.

Such is the distance of this planet from us that nothing like mountains or the outlines of continents and oceans have been discovered in it. Its whole disk, however, is traversed by light and dark belts, running nearly parallel to one another and to its equator, though they have often been known to change both their form and number. These are regarded by astronomers as lines of bright clouds alternating with darker belts of the planet's surface, as seen between them, and having their direction determined by currents analogous to our trade winds, but of a much more steady and decided character, in consequence of the great rotary velocity. But the existence of clouds im-

plies and proves several other important facts—that there is an atmosphere in which they float, that there is water from which they arise, that there is heat by which that water is evaporated, and rain or snow into which they condense. The apparent diameter of the sun from Jupiter is not more than one-fifth what it is to us; consequently the light and heat it derives from him are only about one-twenty-fifth of what we receive; but this deficiency of light is made up in part by the reflection of its four moons, and that of heat may be by the higher temperature of its own body.

While to *us* Jupiter is the brightest, save one of all the planets, our world is altogether invisible to Jupiter. An observer on that planet, with eyes such as we have, would have no suspicion that such a globe as the earth was in existence; its fancied greatness and proud inhabitants all would be utterly unnoticed, and altogether unknown to him. And from the facts now stated, it will appear that the arrangements of this planet, and the condition of things upon its surface must be very different from what obtains in our world. The amount of gravitation, as already stated, being two and a half times that of the earth, its inhabitants rational and irrational (if any it has), if constituted like those of our globe, in order to move and act with ease, must possess two and a half times their strength. Our armour-clad Goliath *there* would be barely able, like a tortoise, to crawl beneath his shield. A man sixty years old, and weighing one hundred and sixty pounds,

if transported to the surface of Jupiter, would find himself an infant of five summers, yet weighing four hundred pounds, but not possessing the strength necessary to take his first tottering step. So diverse are the works of God.

Jupiter has been deemed worthy the attendance of no less than four moons, which constantly accompany and revolve about it; thus forming a miniature system, entirely analogous to the great system of the sun, and moving in the same direction, and obeying the same law of gravitation. These satellites of different dimensions, and revolving at different distances and velocities, exhibit many interesting and sublime phenomena to its inhabitants, as they perform their natural courses through the firmament. Sometimes they are seen eclipsing the sun, at other times the stars, and occasionally eclipsing one another. Sometimes two, three, and even all the four are seen shining in the heavens in one bright assemblage; one, perhaps, in the form of a crescent, one with a gibbous phase, one like a half-moon, and the other with a full enlightened hemisphere; one moving comparatively slowly, and another rushing rapidly through the skies, and leaving all the others behind it; one under a total eclipse, another entering into it, and a third emerging from it.

In Jupiter and its attendant satellites, therefore, we have a most sublime and impressive display of creative skill and might. Could we enlarge our minds and quicken our imagination so as to attain anything like

a lively and adequate conception of a globe 1,300 times larger than the earth, rotating upon its axis with fearful velocity, and flying onward through the heavens at the rate of 29,000 miles per hour, and carrying along with it four large revolving moons in its swift career—we should have before us a scene of overwhelming grandeur, and such as could not fail to call forth the adoring exclamation, "The Lord God omnipotent reigneth!"

Quitting the orbit of Jupiter, and pursuing our outward bound voyage through space, after crossing the stupendous interval of 410,000,000 of miles, we reach the majestic orb of SATURN. This planet together with its rings and satellites, presents the most wonderful and magnificent spectacle in the whole solar system. In magnitude it is a 1,000 times that of the earth, its diameter being 79,000 miles. Its distance from the sun is nearly double that of Jupiter, 906,000,000 of miles; and it occupies nearly thirty years in completing its revolution, moving at the rate of 22,000 miles per hour. Its orbit measures 5,700,000,000 of miles, a distance that a railroad train running at the speed of thirty miles per hour would not travel in less than 21,000 years!

Saturn rotates upon its axis, which is nearly perpendicular, in the space of 10 hrs. and 16 min.; its days and nights therefore, are invariable, and not quite half as long as ours. Its light and heat from the sun are only one-ninetieth of ours. But its condition on this ac-

count is not so dismal or desolate as would appear at first sight. The light of our full moon is estimated by Bouguer to be one-three-hundred-thousandth part that of the sun, and that of Saturn is one-ninetieth part of this; the degree of light upon its surface, therefore, is equal to more than 3,000 full moons, which assuredly must create a day of fair brightness, and sufficient for the common duties of life. In density this planet is below all the others, being only one-ninth that of the earth; in other words, the weight of its materials is but little more than that of cork; but on account of its immense size, its entire weight is equal to one hundred and twenty times the weight of our globe; and the force of gravitation on its surface is somewhat greater than that to which we are subject. Its surface, like that of Jupiter, is traversed by cloudy belts, which indicate the existence of both water and atmosphere.

To Saturn there belongs an illuminating appendage which no other planet possesses. It is surrounded by three broad, flat, and extremely thin concentric rings, all lying in the same plane, and separated by comparatively narrow intervals. Galileo was the first of mortals that caught a glimpse of these wonderful structures. The exterior diameter of the outer ring is 177,000 miles; and its width 21,000 miles. Between this and the interior bright ring there is a space of 1,790 miles; the width of this is little more than 34,000 miles, and its distance from the surface of the planet is 20,000 miles. The thickness of the rings, according to Her-

schell, cannot exceed 250 miles, and who also gives it as his opinion that they are of a vaporous constitution; they are, however, of sufficient density to throw a dark shadow on the body of the planet, and thus occasion a total eclipse of the sun to those parts for a period of nearly fifteen years together. The rings revolve about the planet in nearly the same time that the planet rotates upon its axis. Nothing can exceed the marvellous wisdom, and mathematical nicety of adjustment displayed in all the parts and distances, motions and eccentricities of these rings, so as to preserve them, on the one hand, from flying off from the planet in its swift career, and on the other, from falling down on its surface, and producing a derangement of the whole fabric, Here is machinery in which the calculations of the Great Architect are as manifest as if they had been written out in algebraic formulæ upon its splendid arches.

This planet is also furnished with no less than eight large moons; these revolve in nearly the same plane, and in the same direction as the rings. From the outer ring to the orbit of the first is a distance of only 18,000 miles. These satellites revolve, like those of Jupiter, at various distances and in different periods; and like them also they undergo frequent eclipses, and pass through the same round of phases.

From the foregoing facts it is obvious that the nocturnal firmament of Saturn exhibits a scene of grandeur beyond that of any planet in the system.

Besides the innumerable hosts of stars of various magnitude and brilliancy, there are its eight magnificent satellites, some rising and some setting, some in slender crescents and some full-orbed; together with the luminous arches towering one above another, and stretching from one horizon to another—all this must present a scene of celestial grandeur surpassing all imagination. Saturn with its satellites and rings, doubtless, is one of the most signal, most marvellous, and most direct and clear indications of the Divine Hand, that the whole visible creation presents. It is one of the most startling exhibitions of the Almighty's power and unsearchable wisdom that man has been permitted to contemplate. When the piercing telescope lifts the veil of distance, and reveals this glorious mystery, it creates a thrill of wonder, and awakens transports of solemn joy within the soul, which no words can utter or describe.

Vast is the distance we have already travelled from the great central sun, but now we have again to plunge forward into the dim immensity, and double all this, and at the remoteness of 1,820,000,000 of miles from the sun, we find the mysterious URANUS, a planet whose diameter is not less than 35,000 miles, and bulk eighty-two times that of our own globe, moving at the rate of 15,000 miles per hour. This planet occupies a period of eighty-four years in completing its revolution round the sun. Consequently twenty-two of its years would carry us back to the time when the Son of God

was on his errand of mercy on our own planet. The time of its rotation upon its axis is unknown. Through the most powerful telescopes nothing is seen of it but a small round uniformly illuminated disk, without rings, belts or spots. The quantity of light it receives from the sun is 360 times less than what the earth receives; but according to Bouguer's estimate, before referred to, this is equivalent to more than 800 full moons; and to eyes of higher sensibility, and constructed to take in ten or twenty times the amount of light that ours are capable of, this may be quite sufficient to make a bright and clear day.

Uranus is attended by six satellites. The orbits of these exhibit the most remarkable peculiarities. Contrary to the unbroken analogy of the whole planetary system, the planes of their orbits are nearly perpendicular to the ecliptic, and in these orbits their motions are retrograde; that is, instead of advancing from west to east around their primary, as is the case with every other planet and satellite, they move in the opposite direction. Thus far, this is a profound mystery to all the science of man. It may serve, however, to teach us that God is not limited either in the magnitude or the manner of his operations, and to indicate that we may look for endless diversity in all the worlds his hands have made.

Once more we renew and repeat our outward flight, and after crossing the mighty chasm of 1,000,000,000 of miles we reach NEPTUNE, the last and the farthest

(as far as known) of the planetary worlds. The manner in which this planet was discovered was remarkable. While as yet this remote sphere had never been beheld by mortal eye; while its distance, its position, its mass, and the form of its orbit, were all unknown; by the force and perspicacity of human intellect, from its observed effects, (a mere trembling disturbance,) upon Uranus, more than 1,000,000,000 of miles distant, all these were so accurately calculated as to guide the observer to the very point of the heavens where it was first seen! This fact stands alone in the annals of science, and constitutes a triumph of the human mind, that more than indicates its Divine Paternity and immortal destiny.

Our acquaintance with this planet has been so brief, its distance so great, and its situation in the ecliptic so little favorable for seeing it with distinctness, that nothing very positive can be stated as to its physical appearance. It was at first supposed to have a ring; this, however, has not been verified; but it is attended by at least one satellite. Its diameter is estimated at 39,800 miles. Its distance from the sun is 2,862,000,000 of miles; and the time of its revolution around him not less than one hundred and sixty-four years. "The child, whose fresh dewy orbs to-day look up wonderingly at the spangled vault where Neptune hides itself, will have grown up, fought life's battle, grown old, died, and lain in his grave a hundred years, by the time that frontier planet is able to get around

again to its present place in the sky! According to the Neptunian calender, it is only thirty-six years since the creation of Adam!" *Ecce Cœlum.*

We have now reached the outermost bounds of the great Solar System; and while we pause here for a moment, looking back over the vast and numerous orbs which we have in imagination successively visited, the question springs up spontaneously in the mind, *For what End have these great globes been made, and set in incessant revolutions?* What is the ultimate purpose which they subserve? Are they the abodes of intelligent and moral beings like ourselves? Have we any reasonable grounds to think that they are inhabited by creatures that know, and serve, and worship the Great and Glorious Creator of all?

To this question some have been led to return a negative answer. They see, or think they see, insuperable difficulties in the way of the planets being inhabited, arising in the case of some of them from their being *so near* the sun, and thus subject to too great a degree of light and heat; and in that of others from their being *too far* from him, and so receiving too little light and heat, to admit of their being the abode of sentient and intelligent beings; others of them, again, they look upon as being too small and insignificant for this end; while others still appear too large, their attraction of gravitation, they say, being such as would tie down, if not crush, all organized bodies. But it is obvious that the reasonings of such, and the

conclusions to which they lead, are based upon the supposition, that the planets, if inhabited at all, must be occupied by such creatures as *ourselves*. Now, if the foregoing difficulties, or the arguments derived from them, establish anything, they simply prove that the planetary worlds cannot be inhabited by beings constituted as men are. But if it were demonstrated that man could not live in Mercury, Jupiter, or Neptune, that would be no proof that these globes must be uninhabited. They may be the homes of creatures of other and different constitutions, every way wisely and happily adapted to their several physical peculiarities. It is not to be supposed, indeed, that there are *men* in the planets; but we may reasonably entertain the opinion that each planet has its own wondrous catalogue of living tenants, all adapted to its own particular construction and mass and position. This plan of variety and adaptation we know the Creator has adopted and pursued in the arrangements of our own planet. We behold not only man and the higher animals made for the fairer portions of its surface, but we see the mole and the beetle fashioned to inhabit the mouldering soil; the whale and the clio to choose the half-frozen depths of the polar seas as their most congenial home; the camel and the dromedary to subsist amid the arid sands of the Sahara; the tortuous serpent and the four-handed monkey to dwell in the heated recesses of the tropical forests. In a word, there is not a corner of the earth, nor a cavern of the

sea, but what has its occupants. Even a drop from the green puddle is the home of millions of living creatures. The air we breathe is full of invisible life. Distilled water acting on calcined flint under a glass bell, develops organic life. Even corrosive poisons, strong acids, teem with the living. We are, therefore, not only warranted, but directed to look for life, and an adaptation of life to its circumstances, in every part and province of creation. Matter, as far as we can trace the footsteps of the Creator, appears to have been produced for the purposes of life and intelligence. And we may well and reasonably believe, that it is as easy for God to create a population for the planets as to create the planets themselves; as easy to supply Jupiter with tenants, as the earth with its race of men; as easy to devise the organization of an inhabitant for Uranus, as that of fishes to occupy the ocean; as easy to animate the dust of Neptune, as to make that dust itself. "With God all things are possible." Any arguments, therefore, against the planets being inhabited, drawn from the apparent difference or difficulty in their situation, or constitution, can have but little force or weight.

But if nothing can be said in disproof of planet populations, what, it may be asked, can be said in support of the supposition? We have, indeed, no direct evidence, no positive proof to offer; that is, no living inhabitant has ever been detected in any of the planets; nor have any traces of art or industry, of

cultivation or building, been discovered on their surfaces. What evidence we have is altogether from analogies; but then these analogies are so many, so close, and so striking, that when taken together they amount to a strong probability, if not to conclusive proof, that the other planets subserve the same purpose as our own. These analogies have, for the most part, been pointed out in the course of the preceding descriptions; but to realize their full weight and force, it may be well to collect them into one point of view.

1. To the earth God has given "two great lights;" and for the planets He has done the same thing. To all of them He has given the sun to rule the day; and to many of them moons to rule the night. 2. The earth perpetually travels round the sun, and the time occupied in accomplishing a complete circuit constitutes its year: the planets revolve around him in a similar manner, and thus measure out their respective years. 3. The earth turns round upon itself, thus with each rotation presenting every part of its circumference to the light and heat of the sun: the planets are found to do the same, and to enjoy a similar alternation of light and darkness. 4. The earth revolves in an elliptical orbit, and upon an inclined axis; an arrangement which gives it a variety of climates, and a regular succession of seasons: the planets revolve in similar orbits, and upon axis similarly inclined, which secures to them a like difference of climates, and the same agreeable vicissitudes of seasons. 5. The earth is

encompassed by an atmosphere which refracts the light and retains the heat of the sun: the planets likewise have their atmospheres, creating for them morning and evening twilight, and producing currents or winds that sweep over their surfaces. 6. The atmosphere of the earth is charged more or less with clouds, which often assume every shade of color, change their forms and positions, and send down refreshing showers: the atmospheres of the planets also have their shifting clouds of various shades and tints, and which may minister to them, as ours to us, "all the bloom and luxuriance of vegetation." 7. The cloudy vapors of the earth around its poles in winter condense and fall in the form of snow: a similar fleecy mantle has been observed to cover the polar regions of one of the planets, at least, during winter, and to vanish on the return of summer. 8. The surface of the earth is made up of land and water: and the planets present appearances strongly indicative of the existence of oceans and continents, bays and promontories, similar to our own. 9. The land portion of the earth is ridged with mountains and scooped with valleys: the surfaces of the planets distinctly exhibit similar inequalities of surface. 10. Recent Spectrum Analysis has revealed the fact that the planets contain various substances that are familiar here upon the earth. 11. In short, the planets seem to possess all the elements and arrangements which constitute our own a habitable globe.

Now, who can contemplate all these striking analogies—all these close resemblances in so many particulars to the planet we inhabit, and not be impressed with the high probability, not to say certainty, that those other planetary orbs, which nightly roll over our heads, must also be so many spacious worlds; that, like our own, they teem with life and intelligence? With such an assemblage of circumstantial evidence before us, can it in reason be supposed that worlds so vast, so magnificent, so capable of constituting the home and happiness of life and intelligence, should be vacant balls, mere lumps of dead matter, unmeaning and unenjoyed solitudes, shining fruitlessly in the midst of heaven? If not a foot of our planet has been left without its living inhabitants, can we believe that whole globes, compared with some of which our own sinks into insignificance, have been left tenantless and waste? Has not matter been created in subserviency to life and mind? Why should not the other planets have been created for ends as great and noble as that upon which we dwell? Is it not consonant with reason? Is it not in harmony with analogy, and all that we know of the wisdom and goodness of the Great Creator, to believe that these stately mansions have their sentient and intelligent inhabitants, to travel and contemplate their transcendent scenes of grandeur; that their plains, and valleys, and mountain sides teem with unnumbered millions of happy living beings, that offer up their daily prayers

and adorations to the same Father and God whom we worship and serve? Yes;

> "Each of those stars is a religious house;
> I saw their altars smoke, their incense rise,
> And heard hosannas ring through every sphere."
>
> —*Night Thoughts.*

REFLECTIONS.

The survey now taken of the planetary worlds may serve to teach us our place in the creation of God. We sometimes speak of our world as being *great*, and call it the *universe*, as if it constituted the whole empire of Jehovah. But how humble a position does it occupy, and how small a portion of that empire does it form. Not to speak at present of the stars, those centres of other systems; and the nebulæ, those assemblages of suns and systems; the earth is far from being foremost in magnitude or motions among the globes composing our own system. Mercury, Venus, and Mars, are all its equals in splendor. In bulk, Uranus exceeds it 80 times, Neptune 120 times, Saturn 1,000 times, Jupiter 1,300 times, and the sun more than 1,300,000 times. To the earth has been given the service of but one solitary moon, while those majestic spheres have been deemed worthy the attendance of splendid retinues of satellites. We rank, indeed, with the inferior class of the orbs constituting the system. Let us learn hence "not to look on our globe as the universe of God, but one paltry and insignificant part of it; that it is only one of the many mansions which the Supreme Being

hath created for the accommodation of his worshippers, and only one of the many worlds rolling in that flood of light which the sun pours around him beyond the outer limits of the system."

From the foregoing view of the great system to which our world belongs, we may also learn a lesson of personal humility. If we feel our inferiority in the presence of human genius; if we think our individual possessions poverty as compared with a nation's wealth; if we see our strength to be but weakness before the thundering avalanche; if we deem ourselves obscure compared with him who occupies a throne and rules the millions of an empire; if we realize our puny stature beneath the heights of Alpine mountains—what manner of sentiments should possess our souls in the presence of the INFINITE! A fellow-man after protracted study, much toil, and many fruitless experiments, brings forth a tiny engine that drives his little ship or car at the rate of twenty or thirty miles an hour, and we admire its author, and ascribe to him a triumph—yet what has he produced but an infant's toy beside the doings of the Most High, who hath formed and set in order the machinery of the heavens, and sent forth from His hand countless worlds, rolling through immensity at a speed of 50,000 and even 100,000 miles per hour! In tracing the history of our race, we sometimes pause over the greatness of those who contrived and builded temples, palaces, pyramids and cities—but how such ephemeron greatness sinks, vanishes from the

view, when we contemplate the architecture of creation, its vastness, its undecaying magnificence, its unfading glories! We call him *great* who has marshalled a few thousands of his fellows, and led them to slay and plunder a few other thousands more helpless than themselves, *all* but as a floating swarm of insects in contention—but lift up your eyes, see ONE who directeth all the starry hosts to purposes of beneficence and glory, and doeth according to his will among the innumerable armies of the skies! We look up, with profound deference to him who sways his sceptre over a few provinces, an insignificant fraction of one insignificant globe—with what adoring reverence then should we look up to HIM, who sitteth upon the throne of the universe, upholding all things with the word of his power, and directing the motions and destinies of suns and worlds which neither man nor angel can enumerate! There is nothing great—*there is nothing great, but* GOD! He only hath power. He only hath life and immortality, dwelling in light unapproachable. "O Lord, when I consider thy heavens, the work of thy fingers, the moon and the stars which thou hast ordained, what is man that thou art mindful of him, and the son of man that thou visitest him?"

DIAMETER OF THE SUN, 882,000 MILES.

COMPARATIVE SIZE OF THE SUN AND PLANETS.

THE PLANETARY SYSTEM.

He calleth them all by names, by the greatness of his might, for that He is strong in power; not one faileth.

In the preceding chapters we have considered the position, the magnitude, the motions and the physical peculiarities of the sun, the moon, and the several planets as separate bodies; in this we propose to consider them as composing *one harmonious System.* And herein we shall discover, not the disconnected and jarring results of chance, but the most uniform and the most mathematically exact adjustment of number, weight and measure in every part, exhibiting the most convincing evidences that the whole is the work of one Omnipotent and All-comprehending Mind.

The sun is the centre of the system—the centre of motion, light and heat to all the planets and satellites composing it. And around him all revolve, impelled by *the same forces, and governed by the same laws.* 1. Every planet moves under the antagonistic forces of gravitation and centrifugal impulse. 2. Every planet revolves in an elliptical orbit. 3. Though both the distance and the velocity of every planet vary in different parts of its orbit, yet its radius (vector) sweeps over equal areas in equal times. 4. The squares of the times in which the different planets revolve around the sun are proportional to the cubes of their mean distances from his centre. 5. All the planets move in orbits

that are in, or very nearly in the plane of the sun's equator. 6. All the planets revolve around the sun in the same direction. 7. All the planets rotate upon their axis in the same direction as does the sun himself. —Now, these remarkable uniformities of forces, orbits, rotations, times, distances, areas, and velocities, constitute a clear and conclusive proof that this magnificent system of worlds had its origin, not in blind fortuity, but in one Divine Thought.

Both design and choice are evident in *the way and means adopted to illuminate* the planetary system. It is obvious that this system of globes might have *existed* in a condition of utter darkness; the planets and satellites might have revolved, as they now do, around a central orb that was perfectly dark and cold; and continued their revolutions without day or summer from century to century. But in that case it would have been a defective and useless system; its every globe would have been a cold, and joyless, and tenantless desert. How happened it, then, that one of its globes was wrapped in a luminous envelope, pouring an ocean of light on every hand? And how happened it that that garment of light fell upon the one, the only one in the whole system of adequate dimensions to enlighten all the rest? Had either of the others, even Jupiter the largest of them, been equally brilliant, it would have been but as a rushlight to the system, and even invisible to half its members. And again—How happened it that the one luminous globe of the system

fell to the only position in it, namely the centre, from which it could advantageously and adequately send forth its beams to warm, enlighten, and cheer the whole? Had the luminary of the system, instead of being stationary, revolved, for example, in the orbit of Saturn, its light and heat would have been so unequal on account of the varying distances of the planets, as to prove fatal to every plant and animal upon their surfaces; the earth, for instance, would have been 200,000,000 of miles further from it at one period than at another. How happened it, then, we ask once more, that all the globes of the system are in rapid revolution except one, and that *the one* whose stationary condition was essential to the whole? Here, then, we have a number and diversity of distinct circumstances, yet each so falling out as to concur with the rest in producing a most important and indispensable result, and that in the happiest and most effectual manner that can be conceived. To what conclusion then are we brought? That this vast and splendid system of worlds owes its illumination to mere *accident*, or to design? That the solar lamp was fashioned and lighted up, and fixed so happily in the centre of the temple of creation, to reveal its beauties and wonders, and to warm and enliven its every part, by simple *chance*, or by designing Intelligence? Here every sane mind must come to one and the same conclusion.

Design, evincing profound wisdom and foresight, is manifest in *the character of the orbits* in which the

planets move. The planetary orbits are *all* slightly elliptical, and of small eccentricity. If the planets had been set in motion by any fortuitous cause, we might reasonably expect to find them describing all kinds of orbits—some circular, some oval, some in shorter and some in vastly longer ellipses; approaching and crossing one another at various angles, and in many points; and thus move at constant risk of collision and ruin. Or, they might have been all set in motion in perfectly circular and concentric orbits; but even in that case, as mathematicians are able to demonstrate, their mutual attractions would produce perturbations that would go on increasing until the whole would be reduced to disorder, and finally to destruction. Or, once more, they might all have revolved in long ellipses, and that without risk of coming into contact; but by such an arrangement they would have been at one period of their year two, three, or four times further from the sun than at another, and have been thus hurried with every revolution from the extreme intensity of light and heat to the opposite extreme of rigorous cold and darkness, both equally fatal to all organized existence. But we find the system as it exists free from all these dangers and inconveniences; we see the planets moving in orbits that ensure perfect safety to all, and the highest advantages to each. Now it is evident that in determining their orbits of motion there were a *thousand* chances against conveniency and safety for *one* in their favor; and the question is, shall we thank fate, alike blind to

causes and consequences, or an all-wise Creator that could foresee all possible results, that *that one* was adopted and established?

Design, full of wisdom and benevolence, stands forth conspicuously in *the rotation of the planets upon their axes.* Had the system been the result of fortuity, or mere chance, we might reasonably have expected to find among so many globes, all differing in their sizes, densities and distances, a similar diversity of rotation. Some might have revolved upon axes that perpetually shifted their direction; a condition that would have destroyed all regular succession both of seasons, and of day and night; so that those upon them who one week rejoiced in the sunshine and luxuriance of the tropics, might the next find themselves locked up in the ice and darkness of the arctic circle. Some might have revolved upon axes, pointing, as at present, always in the same direction, but lying in or nearly in the plane of the ecliptic; an adjustment that would produce results exactly equivalent to transferring the climate and condition of the poles to the equator, and those of the equator to the poles, with every revolution in their orbits. Some might have rotated upon axes always pointing to the sun, an arrangement that would have kept one hemisphere in perpetual daylight, and left the other in eternal darkness. Some might have turned so slowly upon their axes as to give only three, four, or half a dozen days in the year; and others so swiftly as to produce days and nights so brief and hasty, as to be

unsuitable for rest or labor. But in the existing condition of the system we discover nothing of this sort; not one of all the planets has been found to rotate in either of these ways, or in anything approaching them; all alike revolve on axes of such a small inclination, from a perpendicular to the plane of the ecliptic, as gives them an agreeable change of seasons, and in periods that afford a suitable interchange of day and night. How then has this happy arrangement come to prevail throughout the system? Whence this fitting inclination of *all the axes?* Supposing chance gave to the axis of one, or two, this degree of inclination, is it likely that the axes of all were set at a similar angle by chance? Or, if chance assigned to one or two a proper inclination of axis, and a suitable speed of rotation, was it chance still that gave both these to all of them? Surely, the designing mind and working hand of the Great Architect could not have been more clearly manifested than they are in this axial adjustment of all the planets.

We discover design the most marked and undeniable in *the degree of velocity given to each planet in its orbit.* We have before illustrated by means of the string and ball how that the centrifugal force of every planet, and the force of the sun's gravitation upon it, are always equal.* Hence it is demonstrable that any one of the planets might have been set in motion at a speed either too high, or too low to follow its intended

* See p. 247.

path. Any one of them might have been started in its present orbit at a velocity too small to carry it even once round the sun, *his* gravitation so far transcending its centrifugal impulse as to draw it down to his surface. On the other hand, any one of the planetary globes might have commenced its career with a velocity so great as would have greatly elongated its orbit, and thus have crossed the orbits of others, and become exposed to the terrific catastrophy of collision with them; or might have been projected even at a velocity that would have carried it beyond the utmost bound of the system. Had Mercury received the tardy rate of Neptune, a few days would have sufficed to precipitate it into the sun; and had Neptune received the high velocity of Mercury, it would have plunged into the depths of infinite space never to return. To preserve their present safe and harmonious orbits, every planet must have received the exact impulse that would communicate to it its present velocity, and that impulse must have been given exactly at such an angle. One, and only one velocity, and that given in one, and only one direction, would have produced the present orbits of the planets. Here, then, it would be folly to ask, Could chance have thus measured these impulses, these angles, these velocities, with infallible exactness? or thus undeviatingly balance the mighty forces of gravitation and centrifugal impulse to a hundred different worlds—different in their magnitudes, in their masses, and in their distances? Here every sane mind is

brought instinctively to the conclusion—*Omniscience and Omnipotence alone were equal to the task.*

We have evidence of design, foresight and calculation, conclusive as a geometrical demonstration, in *the adjustments by which the stability of the solar system, as a whole, is maintained.* The planets as they move in their orbits of necessity attract one another, according to the universal law of gravitation. When at their nearest distances from one another these disturbances become perceptible and calculable; and though they are comparatively small, yet if they went on increasing with every recurrence, they would, in the course of time, inevitably disturb and destroy the system. When this was first observed by Sir Isaac Newton, he became alarmed for its safety, and thought that nothing but the direct interposition of the Almighty could save it. But as the science of physical astronomy advanced, mathematicians became able to calculate and prove that, these perturbations, after reaching a certain amount or degree, gradually decreased until they came back to the point from which they started; that is, that they were periodical, or oscillatory. Every planet after leaving, through these disturbing attractions, its regular path for a certain time, returns slowly to that path, deviates from it on the other side, and again returns and passes to its former limit. Saturn thus returns in a period of 929 years; and Jupiter in nearly the same period. Although these oscillations in some cases occupy thousands of years, yet they are not less

sure and fixed than the pendulum, whose regulated motion marks a *second* of time. Now all this, as Laplace and Lagrange have demonstrated, is secured by three specific and distinct adjustments, namely, the motions of all the planets being in the same direction, their orbits being of small eccentricity, and those orbits being slightly inclined to each other. Upon these three things, under the Supreme Ruler, hang the stability and permanence of the whole system. What a marvellous revelation have we in this fact! Here are scores of great globes, the distance, mass and velocity of every one of them must be in their exact proportions; every one must move in the same direction; every one must have its orbit set at so many degrees of inclination to all the rest; and every one must be bound to such an amount of eccentricity. An error in one particular might have destroyed the whole. If the eccentricity of Jupiter alone, according to Whewell, were increased to that of Mercury, the security for the stability of the system would disappear. What stronger evidence, then, of care and foresight; or what more conclusive demonstration of profound skill and design could possibly have been given or desired? Who can contemplate this proof of the beauty and perfection of the planetary system, and not bow in reverence and adoration before the Omniscient Architect of the heavens, saying, "Great and marvellous are thy works, Lord God Almighty; thou art wonderful in counsel and excellent in working!"

That the Planetary System, then, is the production of a Being of infinite wisdom and power, cannot be doubted. Equally evident and certain is it that *the same adorable Creator presides continually over it*, actuating and guiding its every movement. We have more than once applied to this system the term *Machinery*, but it is machinery totally different from every human production that receives that name. The planetary mechanics are of such exquisite perfection, and their parts move and act upon one another upon principles that render them wholly dissimilar from every contrivance and fabrication of man. In our machinery every thing goes on by contact and impulse; pressure and force by cogs, rods, belts, water, wind, steam, etc., are the means by which motion is transferred to and from every wheel, lever, and spring. But in the machinery of the heavens, we discover nothing of all this. Here we behold spheres, enormous spheres in free and boundless space, without any material or visible connection, separated by spaces that can only be estimated by millions of miles, yet affecting one another powerfully, constantly, and infallibly. Here are worlds on worlds of every magnitude, and placed at every distance—planets, and rings, and satellites—all in ceaseless rotation, and all careering through the trackless void with velocities appalling to contemplate, without any visible power or agency to produce their motions, or to guide them in their unmarked and mighty circuits; yet every one completing

its daily rotation, and accomplishing its annual round of hundreds of millions of miles, without deviating the fraction of a minute from age to age, and from century to century. Here is mechanism the most sublime, mechanism worthy the Divine Architect!

These stupendous evolutions all, as commonly viewed and expressed, are effected by the *laws of nature*, the laws of motion and gravitation; and multitudes there are who never look beyond or above these laws for any other power or agency as being concerned in them. Their conception seems to be, that at some distant period in eternity past, which cannot be defined, the Deity, by a single act of His will, caused the whole universe to start forth into existence, that He impressed all the substances which He created with their respective self-acting properties or laws, that He then left the universe to the government of these laws, and has continued ever since an inactive spectator of the works of His hands. But such an idea, however popular, when sifted, must appear as unphilosophical as it is unscriptural. Let us analyze it. What is Law? Simply, as every one must admit, a Rule prescribing a course of conduct or action. A law, then, is not an efficient agent or force, and, therefore, can do nothing, effect nothing. And certainly matter —the dead, dark, cold, unconscious materials of the planets can of themselves do nothing; can pursue no end, change no direction, produce no motion. If, therefore, neither the laws, nor the planets upon which

those laws are said to be impressed, can do or effect anything, who or what produces their mathematically exact and harmonious motions? Here is an effect, and a most marvellous one—where is the cause? Taking *law* in its proper and only intelligible sense, we are soon conducted to the efficient Cause of all. "Law," says Whewell, "implies an agent, and a power, for it is the mode according to which any agent proceeds, the order according to which the power acts. Without the presence of such an agent, of such a power, conscious of the relations on which the law depends, producing the effects which the law prescribes, the law can have no efficacy. Hence, we infer that the Intelligence by which the law is ordained, the power by which it is put in action, must be present at all times and in all places where the effects of the law occur; that thus the knowledge and the agency of the Divine Being pervade every portion of the universe, producing all action and passion, all permanence and change. The laws of nature are the laws which He in his wisdom prescribes to His own acts; His universal presence is the necessary condition of any course of events, His universal agency the only origin of any efficient force."

This is the correct view of the Laws of Nature and the Divine Agency; and this has been the view entertained by the profoundest students of the works of creation. *Sir Isaac Newton*, in his Optics, declares that the various operations and evolutions of nature

"can be the effect of nothing else than the wisdom and skill of a powerful ever-living Agent, who, being in all places, is more able by his will to move the bodies within his boundless uniform sensorium, and thereby to form and reform the parts of the universe, than we are by our will to move the parts of our own bodies." And *Clarke*, the friend and disciple of Newton, says, "All things which we commonly say are the effects of the natural powers of matter and the laws of motion are, indeed, the effects of God's acting upon matter continually and at every moment." *Sir John Herschell* expresses himself of the same sentiment—"The laws of nature, however general, are the laws which God, in His wisdom, is pleased to prescribe to His own agency. We would no way be understood to deny the constant exercise of His direct power in maintaining the system of nature; or the ultimate emanation of every energy which material agents exert, from His immediate will." So also *McCosh*, in his Divine Government—"Speaking correctly and philosophically, the general laws of nature are just rules which God has laid down for the regulation of His own procedure." *Dr. John Harris*, speaking in his Pre-Adamite Earth on this subject, says, "We believe that the same power which originated matter with all its properties, maintains it in operation by a constant regular volition, acting according to established laws." *Dugald Stewart* holds similar language—"All the events which are continually taking place

in the different parts of the material universe are the immediate effects of the Divine Agency." To the foregoing, quotations of the same import might be added from the writings of *Bacon*, *Pascal*, *Boyle*, and many others; but we shall add one only, from *Sir Thomas Brown's*—"I call the effects of nature, the works of God, whose hand and instrument she only is; and, therefore, to ascribe His actions unto her, is to devolve the honor of the principal agent upon the instrument, which, if with reason we may do, then let our hammers rise up and boast that they have built our houses, and the pen receive the honor of our writings." Such are the devout views and feelings of these great men—men whose names know no superiors in the history of science, and who have called forth the highest admiration of mankind for their great intellectual powers.

We return, then, to our great Planetary System, ascribing its creation in the beginning, its preservation through the ages, and its movements all through every moment to the direct and immediate agency of the Great God. Its light, its motions, its existence, owe their continuance to Him. It is His right hand, under the name of "attraction," that holds the planets from forsaking the sun; and His left, under that of "centrifugal force," that keeps them from approaching Him. What we call "rotation" is but His agency whirling them upon their axes; and what we term their "velocity," is but His power carrying them forward in

their orbits. The perfection of their movements is the perfection of His operations; and their ceaseless evolutions the sensible manifestations of the ceaseless emanation of His power, by which they are produced. "By the word of His power all things consist." And as our image vanishes the instant we withdraw from the mirror, so would the motions and magnificence, the beauty and harmony, of this great system vanish in a moment were God to withdraw from it His supporting and guiding agency. In Him all in the heavens, and all upon the earth, live and move and have their being.

REFLECTIONS.

From the scene of power and wisdom we have now surveyed, we may learn a lesson of *trust—of calm and peaceful confidence in God our Father.* What we have just seen of His works, and of His universal and omnipotent agency, may serve to convince and impress us, that what He hath promised He is able to perform; and that what He hath purposed He will surely accomplish.

Hath He promised the safety of his church, and the spread of the gospel, until the kingdoms of this world shall become the kingdom of His dear Son? Even so then shall it be. All the rank, and learning, and influence, and philosophy of the world shall not be able to overthrow it. Let power lift up its arm, authority promulgate its edicts, bigotry muster its hosts, intolerance point its enmity, and persecution

open its dungeons and kindle its fires, to stay its onward march, it will all be but as though a swarm of bees arose to arrest the majestic orb of Jupiter in its revolution; for the power that bears onward that mighty globe in its course, is engaged, is pledged, to impel this chariot of salvation through all the world.

Hath He promised to watch over the humble believer in his word, and to conduct him in safety through a world of sin and sorrow? He is able to do it, and He will do it. Why doubt it? The mighty globes of matter we have now surveyed, and over which He exercises such unremitting care, have all been formed for the service, the welfare, and the happiness of His intelligent creatures. Does He then care for these their mere habitations, and will He overlook, or forget, or neglect those intelligences themselves? Never.

> "Behold this midnight splendor, worlds on worlds;
> Ten thousand add, and twice ten thousand more;
> Then weigh the whole: *one soul* outweighs them all,
> And calls the seeming vast magnificence
> Of unintelligent creation *poor*." *Night Thoughts.*

Fear not, therefore, thou child of God; He who conducts in safety each planet through the trackless void, will trace out for you the wisest and the safest path through this moral wilderness. The God and Father of all, who so balances the perturbations of a hundred worlds, through all the lapse of ages, as to produce universal harmony and security, can, and will, accord-

TWO REMARKABLE COMETS.

ing to his promise, over-rule all things to work together for good to them that love Him.

Hath He said, "Him that believeth in me will I raise up at the last day?" Then let my body descend to the grave—let my members perish and mingle with the soil—let my dust be scattered to the four winds of heaven, His holy eye will keep unslumbering watch over all. I care not for the incredulity of the Sadducee, nor for the sneers of the sceptic, nor for all the difficulties of the chemist—He who could call this magnificent system of worlds out of nothing, can find no difficulty in calling my body from the grave. He who could aggregate atoms into planets and satellites, can be at no loss to assemble my scattered dust, whether hidden in the sepulchre, or merged in the depths of the sea. He, who, with a word, could kindle up the sun in the splendor of his glories, can also, with a word, call forth my mortal remains, and refashion them into a form lovely and glorious as that of the Sun of Righteousness. The promise of all this is gone out of His mouth, and "sooner shall heaven and earth pass away than that one jot or tittle of it should fail."

COMETS.

He worketh signs and wonders in Heaven.

To the Solar System belongs another class of bodies than planets and satellites, and differing from them in almost every respect—these are Comets, or Hairy Stars,

so-called because their long and hazy tails sometimes resemble flowing hair. These are very numerous; not less than 700 have been astronomically observed; and it is believed that many hundreds more escape observation, by reason of their paths traversing only that part of the heavens which is above the horizon in the day-time.

Comets consist of a large and more or less splendid nebulous mass of light, called the head, which is usually much brighter towards its centre, and presents the appearance of a vivid nucleus, like a star or planet. From the head, and commonly in a direction opposite to that in which the sun is situated, diverge two streams of light, which grow broader and more diffused at a distance from the head, and which generally unite a little behind it, but sometimes continue distinct. Many of the brightest comets, however, have but short and feeble tails; and a few exhibit no vestige of any. On the other hand, instances are not wanting of comets furnished with many tails; that of 1823 had two, one turned toward the sun, and the other from him; while the comet of 1744 had no less than six, spreading out like an immense fan. These tails are sometimes of enormous length; the last named extended to a distance of more than 20,000,000 of miles. The comet of 1680, according to Sir Isaac Newton, in the space of two days after its perihelion, shot from its body a tail not less than 60,000,000 of miles in length; whilst that of March, 1843, had a train of light

stretching away from the nucleus to the astonishing distance of 200,000,000 of miles. These tails occasionally strongly vibrate; and, in some instances, have appeared as if agitated by the wind.

The smaller comets appear only as round or oval masses of vapor, more dense toward the centre, but without any distinct nucleus, and the smallest stars can be clearly seen through the very heart of them. And many of the larger comets appear to be of the same character. Comets in general are bodies of such extreme tenuity, that the most unsubstantial clouds, which float in the highest regions of our atmosphere, must be looked upon as dense and massive bodies compared with the filmy and all but spiritual texture of a comet. Even in the larger and brighter ones, what seems to the naked eye a nucleus, is found, when viewed through a powerful telescope, to possess no solidity; though in some, it is true, a very minute stellar point even then remains, indicating the existence of something more substantial. In all probability, however, comets have a great variety of structure, and among them may very possibly be bodies of widely different physical constitution; and there is no doubt that one and the same comet, at different epochs, undergoes great changes, both in the disposition of its materials, and in their physical state. Halley's comet in 1835–36, presented at one time the appearance of a fan-shaped flame, proceeding from a bright point; at another time it was like a red-hot coal of an oblong

form; at another time it was seen as a well-defined disk, with an apparent diameter of not less than 97,000 miles; and at another time as a brilliant kernel of light, with a diameter varying from 250 to 1000 miles. Biela's comet was actually seen to separate itself into two distinct comets, which, after thus parting company, continued to journey along amicably through an arc of 70° of their apparent orbit. During this separation, very remarkable changes were observed to be going on in both, as they increased and declined alternately in brightness. After being thus disunited for sixty-eight days, the comet appeared again single; and after four weeks more disappeared.

The orbits of the comets are extremely long and narrow ellipses, in which they move most irregularly and capriciously. Sometimes they remain in sight only for a few days, at others for many months; some move very slowly, others again with the most extraordinary velocity; that which appeared in the Spring of 1843, in one part of its orbit moved at the inconceivable velocity of 1,300,000 miles per hour! Not unfrequently the two extremes of slowness and rapidity of motion are exhibited by the same comet in different parts of its orbit. Some move from West to East like the planets, some from East to West in the opposite direction, and others in a tortuous and very irregular course. Nor do they confine themselves, like the planets, within any certain region of the heavens, but traverse indifferently every part. In many in-

stances, if they do not actually intersect, they at least pass very near to the orbits of some of the planets.

The eccentricity of the cometary bodies is equally marvellous; at one period receding far beyond the outermost planet of the system; at another sweeping down toward the sun, and approaching him so closely as almost to graze his surface. The celebrated comet of 1680, coming back from a distance in space of 44,000,000,000 of miles, approached the sun within one-sixth of his diameter; while that of 1843, at its nearest point, was only one-fourteenth part of his diameter from his surface. What an extraordinary fact does this latter present! Were the earth placed at this proximity to the sun, his fierce glare would be increased 47,000 times, and would pour a degree of heat upon it sufficient to melt into liquid and convert into vapor the hardest substances of which it is composed.

The orbits and periodical returns of some thirty-five or forty of the comets have been calculated. That known as Enck's comet revolves in 3 yrs. and 3 ms. Biela's in 6 yrs. and 9 ms. Halley's occupies a period of 76 years in completing its mysterious round; this was observed by Kepler, good and great man! thrice since he departed from our world has that wandering comet looked down upon us from the skies, beaming each time with its misty ray upon the graves of the generation which last beheld it; its next return will be in 1911, and what changes will it again then

witness in our agitated and transient world? The period of another comet has been set at 575 years. "The comet of 1811, when it last saw the earth, saw it yet dripping with the waters of the flood." Others are supposed to occupy no less than 100,000 years in completing their revolutions!

Although modern science has thrown much light on the orbits and movements of comets, yet their nature and the offices they perform in the economy of our system are as much unknown as ever. In truth, the more they are studied, the more mysteries are developed in connection with them; a fact that led the celebrated Olbers to make the striking remark, that "the obscurity and unintelligibility of the nature of these extraordinary bodies are greatly on the increase." What the power is that, contrary to the force of gravitation, darts forth their vast appendages with such incredible velocity, and to such immense distances, is wholly unknown; nor is it conceivable, says Herschell, that matter once projected to such an enormous distance should ever be collected again by the feeble attraction of such a body as a comet. What then becomes of it? No answer can be given. Here seem to be forces in operation unknown to human science. In dealing with comets all earthly analogies fail us. "We look upon a planet, and we know something of what we see; we turn to a comet, and there is nothing that we can comprehend. The planets tell us of so many resemblances to ourselves, that we can

form some probable inferences; the comets are utterly silent—or rather, they speak loudly of their Creator's glory, but in a tongue that no man can understand."

REFLECTIONS.

The cometary system opens before us a scene of creation of which we know but little, and presents phenomena of which we can give no account. Whatever scientific progress or achievements we may have made, we are here admonished to be modest and humble, by being reminded that the *unknown* is vastly, boundlessly more than the *known;* that before us is still an illimitable and unfathomable ocean to be explored. There is something in the aspect, in the presence, of a sweeping comet, especially calculated to remind us that we are also in the presence of its glorious Creator. Here we experience something beyond the ordinary impression of grandeur—something fearful and peculiarly solemn! He who can look up to these stupendous mysteries as an atheist or an infidel, let him withdraw from beneath the sacred canopy of the heavens, and hide himself in darkness and silence, as a living reproach to his Maker.

The days have been when the appearance of a comet inspired universal disquietude and alarm, being taken as a sure prognostic of some direful calamity or disaster. Princes, popes and peoples were alike perplexed and terrified by the sight of these ominous wanderers in the heavens, as they glared down in their fiery splen-

dor, or gave forth their pale, livid, watery light, or extended their enormous trains like a bent and bloody sword athwart the firmament. But light at length has emancipated men from the bondage of this fear. We, of to-day, having better knowledge of the character and motions of these once portentous visitants, see that the alarm and agitation of our ancestors were groundless, and can smile at their ignorance while we pity their terror. But after all, do we not betray similar ignorance, and yield ourselves to equally unfounded apprehensions many times? We cast an anxious eye over the firmament of our *future*, and think we discern in it certain omens of coming evil—of the loss of health, or wealth, or friends; and thus suffer from similar fears, and perhaps to an equal extent with those who saw prodigies in the bloody hue or flaming tail of a comet. Are we not here in equal error? For does not all this tormenting anxiety spring from ignorance, or else forgetfulness, that the God who guides the planets and the comets in their courses, governs the affairs of nations and individuals upon the earth by wisdom and by laws equally infallible? Certain it is that the worlds of human thought, and action, and destiny, no less than those resplendent worlds of matter, hang upon the will of Him who worketh all in all. Superior intelligences, angels and the spirits of just men made perfect, who have larger and clearer views of the Divine administration, look down upon us, as we look back upon the ignorant and superstitious of

former days, and regard with mingled regret and compassion our folly and disquietude. To them it is as evident as that every sphere in heaven has its fixed orbit, and comes and goes at its appointed times, that every change and revolution among men has its own wise and determinate direction, and that every event is brought forward in its due time and place. No sooner were announced to men the laws which govern the comets in their mysterious visitations, than they ceased to be dreaded or looked upon as prodigies; so were we elevated to the light and faith of these exalted beings we should at once dismiss both our alarms and complaints. We should see that eternal Wisdom marshals the great procession of humanity, directing their course through all the ages, embracing within His care all their interests, and accomplishing His purposes, whether they lie in ignorance, or slumber in apathy, or oppose in madness. We should discover that man is lifted up or cast down, that fortune goes and comes, that plans succeed or are overthrown, that health and wealth fade or flourish, according to the counsel of His will; and that nothing is by chance, though many in their ignorance of causes may think so. We should see that the events and deeds of time are governed as well as judged by the laws of eternity; and that as the vapory comets are wheeled round by the potent attraction of the sun, so the plans and caprices of fleeting existences bend to the immovable Omnipotence, who plants His foot on all the centuries, and has neither

change of mind, nor yields to repose, in accomplishing for them His purposes of mercy and grace.

In the history of Comets, or rather of their appearances, we are presented with a striking illustration of the *all-embracing character* of Divine Providence—how it works in patient and unfailing continuity from generation to generation, combining events the most remote in time and objects the most distant in space, and pressing into its service agencies the most insignificant and influences the most transient, for the accomplishment of its purposes. As all nature is a connected system, so we find that all events are parts of a connected scheme. Nothing in either is found isolated or alone. The whole of the present stands related to the whole of the past. If we searched the records of history to find an event with which *we* are totally disconnect, and to which we owe nothing, we could not perhaps alight upon one more likely to be of this character, than the fleeting appearance of a comet, that took place a thousand years before we were born. Yet, even to the appearance of such a comet we may be not a little indebted both for what we are and what we enjoy. In the providence of heaven, comets, distant as they are, fleeting mysteries as they are, have been made to contribute important influence in shaping the destiny of many nations, and therefore in shaping our own. They have, indeed, been prime actors in some of the most critical and decisive events in human history. They have dethroned kings, humbled popes,

emptied treasuries, subdued kingdoms, and turned to flight the armies of aliens. And strange at first thought, as it may appear, to comets the foremost nations of the world owe, in no small measure, their present civilization, politics, and religion. Let us explain this.

In the year 837, when Louis le Debonnaire was on the throne of France, the comet, now called Halley's, made its appearance in the firmament. This monarch no sooner beheld it, than he concluded it was sent to announce to him new misfortunes; to avert which, he exhausted all his resources in the foundation of religious houses, in building churches, monasteries and nunneries, and in richly endowing them; in this way he hoped to turn away that heavenly anger, which was so evidently, as he supposed, manifested against him. From that day forward, the influence of these great establishments was powerfully felt throughout the nation. At a later date, another splendid but alarming comet appeared in the nocturnal heavens of Europe, Charles V. being now emperor; this prince, like Louis, made no doubt that it addressed itself to him, as being the greatest and most illustrious monarch of his time; and it speedily brought him to the resolution of abdicating his throne, which he did at once, and sought refuge in a monastery, hoping that the evils which threatened him as a monarch would not pursue him as a monk. Now, who but must perceive that comets, by creating and endowing so many religious institutions and inducing this change of civil rulers,

must have exerted a wide and prolonged influence in shaping the subsequent history, and in determining the present character and condition of European nations.

Halley's comet visited our system again in the year 1456; and this time, found the Christians and Mohammedans engaged in a bloody conflict at the siege of Belgrade. Displaying its flaming length in the heavens, it at once arrested the attention and awed the minds of the combatants. Believing it to be a sign against the Turks, 40,000 Minorites rushed to the assistance of their Christian brethren, all unarmed, but each bearing a crucifix in his hand, declaring it to be a token of God's anger against the Mussulmans, which so intimidated the latter, that they turned and fled, leaving their wounded and slain upon the field, and abandoning in their flight the materials and treasures which it occupied years to collect. Thus did the Mohammedans experience a defeat, and their cause suffer a check, which, says the historian, it seems impossible to suppose they could have incurred, had it not been for the interposition of the comet.

Again, history reveals to us the fact that one of these mysterious visitants exerted a potent influence upon armies and upon an empire with which we stand more immediately connected. In the month of April, A. D. 1066, William of Normandy crossed the British Channel, and invaded England. Just at that time a comet made its appearance, glaring down upon the Island. Suddenly the idea took possession of all

minds that its advent was the precursor of his conquest. Men began to exclaim *Nova stella, novus rex!* A new star, a new king. Arms and eyes were everywhere stretched forth toward the portentous sign; and Harold, the king of the Britons, himself is said to have gazed upon it with a saddened look. And this, more than anything else, we are told, crippled the energies of himself and army, and gave William an easy victory over him. But for this comet, then, and the superstitious ideas engendered by its appearance, who can say what would have been the fate of England, or the condition of the world, at this day? Certainly not such as it has been for the last 800 years—probably something far less enlightened, less prosperous, less happy.

We see hence, then, the all-embracing and all-connecting character of the Divine Providence; it combines the affairs of earth even with the revolutions of heaven, and times the recurrence of the one to the crises of the other; employs the ignorance and superstition of one generation to open the channel out of which are to issue the light and science of another yet distant in the future; comprehends all agents, and unites all actions, into one unfailing scheme, to bring about the purposes of eternal wisdom. "His kingdom ruleth over all; and His dominion endureth throughout all generations."

THE FIXED STARS.

By the word of the Lord were the heavens made, and all the hosts of them by the breath of His mouth.

In our outward flight through the solar system, we traversed distances, compared with which, all earthly measurements dwindled into insignificance; yet when we had reached the orbit of the remotest of all the planets, 3,000,000,000 of miles from the centre, we had scarce set foot on the threshold of the temple of creation. While we remain among the planetary worlds, we are among our near neighbors; and while we continue within the limits of the solar system, we are comparatively at home in the boundless universe of God. If now we advance to the study of the fixed stars, those myriads of lights which nightly sparkle in our firmament, we must leave far behind the utmost bound of our own system, pass through dark and pathless regions, and pierce into depths of space, the very thought of which awes and overwhelms the mind. Among the stars we are brought to contemplate, to confront distances, magnitudes, and movements that convey the sublimest ideas of the INFINITY of the Creator to which the human mind can ever rise.

The fixed stars, then, do not belong to our system of the creation. They do not, like the planets, own the dominion of our sun; they do not circle round him; they do not yield to his attractive influence;

neither are they enlightened by his rays, but shine by their own intrinsic light. The attraction and the light and heat of our sun diminish, waste out, and become extinct long before those profound depths are reached. Nevertheless, attraction and motion, light and heat prevail among them, and are governed by the same uniform laws as they are among the bodies of the planetary system.

That the stars are at an incomparably greater distance than the planets is obvious from two simple considerations. The earth at one point of its orbit is nearly 200,000,000 of miles further from some of them than at the opposite point; and yet this enormous space makes no sensible difference in their apparent size. Again; the planets, when viewed through a powerful telescope, exhibit a circular phase or disk, capable of being magnified and distinguished into parts and features; Venus and Jupiter can be made to appear as large as, and even larger than, the full moon: but no telescope can thus magnify the stars; through the most powerful glasses ever invented, they are still but mere specks or points of light. These considerations alone, then, prove them to be at an inconceivable distance.

For a long time the distance of the fixed stars was regarded as utterly beyond the calculation of man. The method used for computing the distance of the moon and the sun from us would not apply to them. The diameter of the earth afforded no adequate *base*

line for the calculation; and even the diameter of the earth's orbit, 190,000,000 of miles, was found to be but little better—in passing from one extremity of this immense line to the other extremity, not the least change was observed in the apparent positions of the stars; the keenest scrutiny could not detect the slightest displacement among them. At length, however, instruments of sufficient delicacy and perfection were invented to mark *a difference*, though extremely small, and the human mind triumphed over what had so long appeared insuperable. In the year 1839, Henderson, a British astronomer, succeeded in calculating the distance of the star known as *a* Centauri, and found it to be no less than 20,000,000,000,000 of miles; a space which it would occupy light, travelling at the rate of 12,000,000 of miles a minute, 3 yrs. and 7 ms. to pass over. About the same time, Bessel, a German astronomer, determined the distance of the star 61 Cygni, which is three times that of the former, or 63,000,000,000,000 of miles. Sirius, though the brightest of all the stars, is six times the distance of *a* Centauri, or 120,000,000,000,000 of miles. The beautiful star called Capella, is at such an enormous distance, that it occupies light to travel from it down to the earth no less a period than 72 years! Yet these are among the nearest of the stars; "the hosts of heaven" lie still immeasurably further in the depths of space. And as for those stars which are visible only through powerful telescopes, their distances are so inconceivably immense,

that their light must have taken a longer period to reach our globe than has elapsed since the creation of man; whilst rays of light coming from the stars composing one of the remotest nebulæ, according to Herschell, must have been millions of years on their way! These are distances which the human mind is utterly impotent to grasp. We can state them in words, and can exhibit them in figures, but the intellect of man can form no clear or adequate conception of them by any effort of which it is capable.

Overwhelming—bewildering—as these distances are, yet were it possible for us to wing our flight to the remotest of the orbs of light to which we have now adverted, whether to the East or to the West, to the North or to the South, it is not improbable that we should still see other myriads in each direction as far beyond. And were we to repeat such a flight to these again, the boundaries of Jehovah's empire, we may well suppose, would be yet unreached and undiscovered! There is nothing in such a supposition that should be regarded as incredible; for He filleth immensity with His presence; His wisdom and power are infinite; His plans are vast and boundless, and inconceivable to the minds of mortals. "Great is Jehovah, and of great power; His understanding is infinite. Behold the heaven, and heaven of heavens cannot contain Him."

Distant as the stars are, astronomers have contrived to detect a number of interesting phenomena connected

with them. Some stars are observed to increase and decrease regularly in brightness, within fixed and definite periods; these periods in some are only a few days, in others many years. Some stars seem to vary fitfully in their magnitude and brilliancy. Others again appear from time to time in different parts of the heavens, blazing forth with extraordinary lustre, and after remaining awhile apparently immovable, die away leaving no trace. Many stars that once shone brilliantly in the firmament, are now missing. "Such changes in bodies so far removed from our system, and of magnitude so enormous as the least of them must be, naturally lead to the conclusion, that revolutions of vast extent, and operations conducted on a most magnificent scale, are incessantly going forward in those remote and inexplorable regions."

Among the most wonderful revelations of siderial astronomy are what have been called double, triple, and multiple stars. When a telescope of considerable power is directed to certain stars, which appear single to the naked eye, they are found double, one star being quite adjacent to the other. Others, again, are found triple, &c. These are found to revolve around each other; that is, two, three, or four suns, together with their respective systems, revolve round one another, or around their common centre of gravity. This assuredly is a most sublime conception. What can be more august or overwhelming than the idea of resplendent suns revolving around other equally resplendent

suns; of suns encircled with numerous retinues of planetary bodies, all in rapid motion, around other similar suns, over immeasurable circumferences, and with a velocity surpassing all human comprehension, and carrying all their planets with them in swift career. Yet nearly 6,000 such systems of double stars have been discovered.

A most curious and interesting fact connected with these multiple systems is, that one sun differs in color from the other suns in the same system. In some instances, one sun is yellow and another blue; in other cases, one is of a crimson hue, while another is of a vivid green. What a variety of illumination two, three, or four such suns must afford to the planetary worlds circling around them; what charming contrasts and grateful vicissitudes—a red, a green, and a yellow day alternating with a white one, and with darkness. One hemisphere of a planet may be illumined with a yellow sun, while the other is at the same time enlightened by a green; and both may shine occasionally on the same hemisphere, producing such a blending of colors, and such a contrast of hues over the whole landscape, as to render the aspect of the scene completely different at one time from what it is at another. In different parts of the planet's courses around their primary sun, these effects will be variously modified, so as to produce almost a perpetual variety in the scenery of such worlds. A sun of a brilliant white may be seen rising, while another of an equally

brilliant green is on the meridian, and one of crimson red just descending below the horizon. And when all are absent, the starry firmament will appear in all its splendor, and every object around present a beauteous and pleasing contrast to its previous appearance. Here, then, are scenes of creation brought before us of surpassing wonder and glory. In the constellation of the Southern Cross is found a cluster of more than a hundred variously colored stars or suns, exhibiting all the various shades of red and blue and green; and so closely thronged together are they as to appear in a powerful telescope like a diadem thickly set with the most glittering gems; while all around are scattered those that look like drops of blood!

From the immense distance of the stars we are at once brought to the conclusion, that they must be bodies of stupendous *dimensions*, otherwise they would be altogether invisible from our world. It is demonstrable that our sun, at the distance of the nearest of the fixed stars, must appear only as one of the smallest of those visible to the naked eye. And this fact alone serves to show, that they must be globes at least equal in size and splendor to the sun, while many of them doubtless are vastly larger.

Another thing that goes to prove that the stars are immensely large globes, is the degree of light which many of them shed. Experiments plainly indicate, that were the star Sirius and our sun placed at equal distances from us, that star would impart an amount

of light 14 times greater than that of the sun. The diameter of the star Vega has been calculated to be 38 times that of the sun; consequently its bulk must be 55,000 times that of the sun. What a stupendous orb must such a star be! The earth we call a large globe; other of the planets are hundreds of times larger; and the sun is 500 times larger than all the planets and satellites put together—what then must that body be which is 55,000 times larger than the sum of the whole solar system! The bright star Lyra, it is said, would fill the orbit of Uranus, which is 3,600,000,000 of miles in diameter. And Sir John Herschell gives it as his opinion, that there are among the nebulous stars those of dimensions that vastly transcend even this. Such magnitudes overpower the imagination, and completely baffle our highest effort to form a conception of them. Our inability to conceive of such mighty masses, however, affords no ground for disbelief of the facts. Scripture and science completely harmonize in the views they give of the INFINITE CREATOR. "Great things doeth He past finding out."

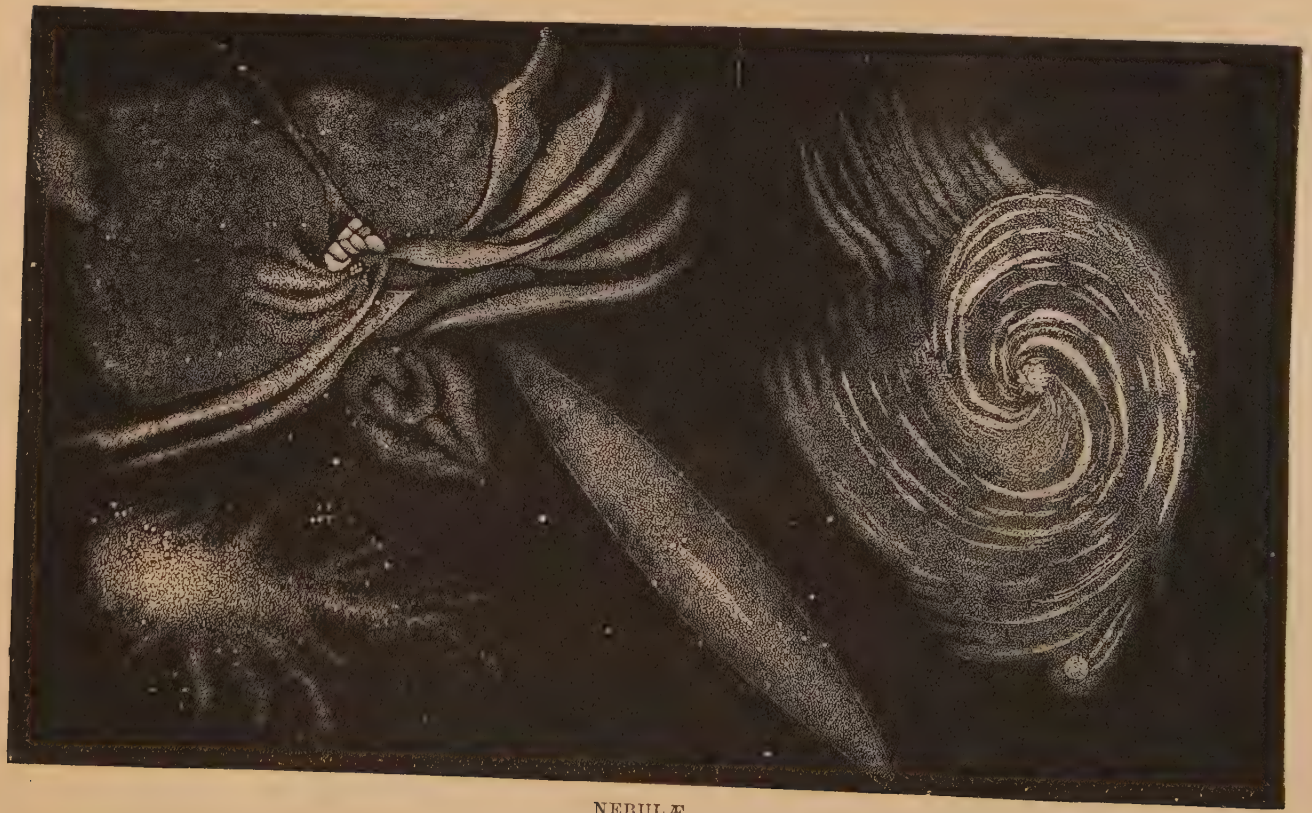
The *number* of the stars is equally astonishing. "Numerous as the stars of heaven," has been a proverbial expression from ancient days. Yet ordinarily there are not more than 1,000 visible to the naked eye at one time; and not more than 6,000 in both hemispheres under the most favorable circumstances. But these are only the beginnings of the glories of the heavens. When the telescope is turned toward the

sky, stars before unseen come forth by myriads from the dark depths of space; and as the power of that instrument is increased, other myriads still come to view; and so on without limit.

> "Come forth, O man! yon azure round survey,
> And view those lamps which yield eternal day.
> Bring forth thy glasses; clear thy wondering eyes;
> Millions beyond the former millions rise;
> Look further—millions more blaze from yonder skies."

The *Milky Way*, as it is called, is but a cluster of stars. Spaces of it not larger than the apparent size of the moon contain many hundreds of stars. "This remarkable belt," says the Elder Herschell, "when examined through a powerful telescope, is found to consist entirely of stars scattered by millions, like glittering dust, on the black ground of the general heavens." And Sir J. Herschell says that, in two hours 147,500 stars swept by his telescope; and that in both hemispheres the number of stars that can be distinctly counted within this belt must exceed 5,500,000. "That the actual number," adds he, "is much greater, there can be little doubt, when we consider that large tracts of the milky way exist so crowded as to defy counting, not by reason of the smallness of the stars, but their number."

But the whole of the Milky Way is only *one* of those clusters of stars, called nebulæ, that are scattered through space. Of these nebulæ not less than 3,000 have been observed and examined. Each of these



NEBULÆ.

TELESCOPIC VIEW OF NEBULA.

appears to be composed of stars as thickly clustered as the milky way. Of one of them, Sir J. Herschell says, "Ten or twenty thousand stars appear to be compacted or wedged together in a space not larger than a tenth part of that covered by the moon, and presenting in its centre one blaze of light." What, then, must be the number in the whole of that nebulæ? And, if to all the foregoing we add the stars of 3,000 other nebulæ, or milky ways, what a boundless scene is presented to the mind!

The survey now taken of the distances, magnitudes and numbers of the stars, naturally suggests the question, What are these stars? these millions on millions of luminous orbs, scattered above, below, and on every hand, through the depths of space? In a preceding paragraph we have spoken of them as being suns, each the centre of a system of worlds, like our own sun; and analogy, all the analogies we have, favor this supposition. What else can they be? We cannot view them, being as they are the productions of infinite wisdom, as having been called into existence for no other purpose than to throw a tide of useless splendor over the solitudes of immensity. Nor can we suppose that they have been formed to give light by night upon the earth, for that would be absurd, as one small additional moon would give more light than they all; besides this, there is comparatively but a small portion of them even visible to our world; myriads of myriads of them lie far beyond the reach of the unassisted eye.

For what conceivable end, then, have these stupendous globes been created? Like our sun, each of them is placed at an immense distance from all others; like our sun, they shine by their own light; like our sun, they are globes of stupendous magnitude; and, like our sun, as far as observation has reached, they turn upon their own axes—why, then, may we not suppose, that like our sun, also, each of them is the centre of a system, and gives light and heat to numerous planetary worlds revolving around it? It is true that we see not these planets, their distance is such as to render that impossible. At far less than one-half the distance of the nearest star every planet in our system is invisible, and the sun itself appears only as a diminutive star. To us, therefore, this may be the case of other suns and systems—the case of those immensely distant stars and their encircling worlds. Those stars that exceed our sun by many thousands of times, both in magnitude and glory, may be attended by splendid retinues of planets, exceeding in the same proportion every thing belonging to our system, and yet be altogether invisible to us. Why, then, should we doubt that each of these stars is the centre of a vast and magnificent system of worlds, similar to that to which we belong? This, at any rate, seems to be the most rational conclusion that we can form, and is the view entertained by astronomers generally. "Worlds roll in these distant regions," says the eloquent Chalmers, "and these worlds must be the mansions

of life and intelligence. In yon gilded canopy of heaven, we see the broad aspect of the universe, where each shining point presents us with a sun, and each sun with a system of worlds; where the Divinity reigns in all the grandeur of His attributes, where He peoples immensity with His wonders, and travels in the greatness of His strength through the dominions of one vast and unlimited monarchy."

In surveying this broad and boundless aspect of the universe, and gazing into these immeasurable and awful depths of space, it is of pleasing interest to observe, that while mystery heavy and almost oppressive hangs over the scene, *system* is clearly discernible throughout, and law and order everywhere prevail. While all the visible objects of the heavens—suns, planets, satellites, rings, comets, nebulæ—are all in ceaseless revolution, absolute rest being unknown in the material creation, yet nowhere within the utmost sweep of the telescope has there been discovered anything like disorder, chance, defect, or confusion. "It may be most confidently affirmed," says McCosh, "that nowhere within this extensive region, or in the long ages opened up to us by the time which light requires to travel from different stars, do we discover any traces of a chaos now existing, or ever having existed, or of worlds being formed by natural law, or of worlds only half formed or in the course of formation, or of any object overlooked, or out of place, or not in harmony with all the rest. As far as the telescope can carry our

vision, or enable thought to carry out its calculations, we find all the bodies already formed, already in harmony, moving on in their spheres as if performing some great and good office, and all so perfect, that our feelings are in harmony with the declaration of their MAKER, when He is represented as proclaiming them to be 'all very good.'"

REFLECTIONS.

The siderial heavens present the most impressive and sublime manifestation of *the universal presence and agency of the Great God.* As true philosophy unites with Scripture in attesting that *all life* and *all motion* proceed from God, wherever, therefore, we behold either of these, we behold a certain token of the Divine presence and agency. Now direct our eyes to whatever quarter of the heavens we may, explore we the regions of the Nadir or the Zenith, look we to the East or to the West, to the North or to the South, and from the centre of the little globe upon which we stand to the remotest limits of telescopic vision, we behold a scene of perpetual revolutions and incessant activity; we discover the mighty power of God impelling and guiding planets, suns, and systems through every region of immensity. "He bringeth out their hosts by number; He calleth them all by their names, by the greatness of His might, for that He is strong in power; not one faileth." And this He has been doing for thousands and thousands of years, even from the

beginning, yet "fainteth not, neither is weary." Magnitudes do not overpower Him; distances do not fatigue Him; multiplicity and variety do not bewilder Him. While His mind is abroad over the whole vast creation, and His hands are employed in guiding its countless orbs, He is as essentially and intimately present in every one of them, as if it constituted the sole object of His attention; giving life to all its tenants, spreading out all its charms, and bringing on all the changes that enliven and beautify its scenery.

"I am a GREAT KING, saith the Lord of hosts;" and the extent and magnificence of His dominions, as revealed by astronomy, prove Him to be such, indeed. Cast our eyes in what direction we please, or stretch our imagination to the utmost of its power, and we can tell neither where those dominions begin, nor where they end. It has been calculated that there are within the reach of the best telescopes more than *two billions of worlds*—a number so vast that, counting a hundred per minute, it would take no less than 40,000 years to enumerate them! Yet, men of sober minds and profound intellects have advanced the supposition, that were even *all these* to be swept away into nothingness and oblivion, the universe of God would be still left in its greatness, and that its glory would suffer no more by the event, tremendous as it seems to us, than would the forest by the dropping of a single leaf! What, then, must be the whole realm of God? And if we advance still, and suppose, in accordance with what

seems to be probable, that the innumerable worlds embraced within His vast dominions have all their days and nights, seasons and years; that they are peopled with an endless gradation and variety of intelligent beings, who can reckon these days and years, and employ these seasons in the pleasing duties of mutual benevolence and united devotions; that they are adorned with altars of incense and temples of praise; that Divine communion is enjoyed, and hosannas ring through every sphere—how immense, how incomprehensible the empire of JEHOVAH! How great HE, who, with the word of His power, summoned all these into existence, set their magnificent and innumerable globes in incessant revolution, and still upholds and guides them every hour, every moment! Who can gaze at the midnight heavens, and mark the myriads of their glowing fires, and not be moved with profoundest awe and reverence at the presence of Him who kindled and fixed them there, and for whose pleasure they are and were created?

The view we have now taken of the boundless empire of God, serves to set forth in the most illustrious and attractive light, *His love and humiliation in the redemption of our fallen race.* We have seen that our whole terrestrial abode is, in the vast creation, but as a leaf to the forest, as a single grain to a mountain of sand. Yet to save the insignificant occupants of this insignificant ball, God gave His only begotten Son to live among them, and to die for them. "God so loved

the world!" Herein were condescension, love, and mercy that must have amazed the universe. What was our little world, amid an infinitude of spheres of transcendent magnitude and splendor, that He should make it the object of such a gift! And what was our race, our sinful and wretched race, that it should have thus awakened His pity and engaged His love, while songs of praise regaled His ears, and the incense of pure adoration delighted His heart, from the countless multitudes of innumerable worlds! Had our globe and all that dwelt upon it sunk into eternal darkness and annihilation, it would not have taken one ray from the sun of His glory, nor one drop from the ocean of His happiness. And had He thus, in one moment, wiped it and them out of existence, as a stain upon the fair face of His creation, a holy universe would have approved and adored the deed as just. But wonder, O earth! and be astonished, ye heavens! while He sat enthroned high above all, and reigned in glorious majesty over the magnificence of an unbounded creation, He was mindful of the lowest and the least of the works of His hands. He would not have this one revolted world perish. Leaving "the ninety and nine" on the bright celestial plains, He came down to seek and to save "the one stray sheep."

And the means by which our redemption was effected—how astonishing! And how was this accomplished? It was not by a mere volition, or an act of omnipotence, such as brought our world and its inhab-

itants into existence. Had our Father in Heaven, indeed, put forth His power, and created a *new world*, abounding with richer displays of His adorable perfections, and removed us thither from all our present guilty associations, to dwell evermore amid scenes of purity and radiant glory, in order to reclaim us to obedience and holiness—this would have been a deed of benevolence toward wilful transgressors that might have well awakened transports of joy among all holy intelligences. But not thus was our redemption wrought out. A Law unbending in holiness, and inexorable in justice, had been violated and dishonored —a Law demanding a mighty *Sacrifice* before the offenders could be released. HIMSELF, therefore, as no other was adequate, willingly becomes this sacrifice; lays aside the glories which He had with the Father before the world was, descends to our accursed earth, takes upon Him our nature, labors and suffers for our good; subjects Himself to persecution and injury, to reviling and scorn, to buffeting and spitting, and, at last, to be, by wicked hands, crucified and slain! This, *this* was the stupendous price of our redemption; and thus was it paid by Him, who, with His word, had created the earth, and by His Spirit had garnished the heavens. O miracle of loving kindness! Had such a sacrifice been offered to save from impending evil beings the loftiest in the scale of created intelligence, beings the most obedient and loving, beings the most innocent and holy, it would have been a display of

love worthy an anthem peal of ecstatic praise from all the heavenly hosts. But not for such worthy beings was it offered; but to rescue the obscure and insignificant dwellers of his footstool earth; to save enemies, rebels, wilful offenders, immersed in sin and guilt, and justly deserving his everlasting displeasure and abhorrence. Here, then, was love! love which earth has no language to express! love which no burning seraph before the Throne can set forth, or comprehend!

God so loved the world! The Just dies for the unjust! With what sublimity of goodness, with what deep parental love and tenderness, does the work of redemption invest the Divine Character! "O Lord, our Lord, how excellent is thy name in all the earth! When I consider thy heavens, the work of thy fingers; the moon and the stars which Thou hast ordained; what is man that Thou art mindful of him; and the son of man that Thou visitest him? All thy works praise Thee, and thy saints shall bless Thee."

Begin, my soul, th' exalted lay,
Let each enraptured thought obey,
And praise th' Almighty's name;
Lo! heaven and earth, and seas and skies,
In one melodious concert rise,
To swell th' inspiring theme.

Ye fields of light, celestial plains,
Where gay transporting beauty reigns,
Ye scenes divinely fair;
Your Maker's wond'rous power proclaim,
Tell how He formed your shining frame,
And breathed the fluid air.

Join, ye vast spheres, the loud vocal choir;
Thou, dazzling orb of liquid fire,
  The mighty chorus aid:
Soon as gray ev'ning gilds the plain,
Thou, moon, protract the melting strain,
  And praise Him in the shade.

Ye angels, catch the thrilling sound;
While all th' adoring thrones around,
  His boundless mercy sing;
Let every listening saint above
Wake all the tuneful soul of love,
  And touch the sweetest string.

—*Ogilvie.*

The Fifth Day.

Fishes, Fowls, and every winged thing are created.

THE FIFTH DAY.

GENESIS 1 : 20–23.—And God said, Let the waters bring forth abundantly the moving creature that hath life, and fowl that may fly above the earth in the open firmament of heaven. And God created great whales, and every living creature that moveth, which the waters brought forth abundantly, after their kind, and every winged fowl after his kind : and God saw that it was good. And God blessed them, saying, Be fruitful, and multiply, and fill the waters in the seas ; and let fowl multiply in the earth. And the evening and the morning were the fifth day.

WE have now advanced through four days of the creative process, and as the fifth opens upon us, the earth, that ere while was dark, without form, and void, is found a beautiful world—the heavy darkness has passed away, the waters are collected, the continents and islands are elevated and stocked with vegetation in all its variety, the pleasing alternation of day and night is established, the clouds float their soft and golden fleeces over the landscapes, the waters of sea and lake sparkle in the sun-light, and the rivers flow in soft murmurs or rapid currents along their new-made channels, while gentle breezes, enriched with the sweet odors of the fresh vegetation, are fanning the face of nature. But as yet there are no living tenants to behold or to enjoy the new creation; it is a scene without the breath of life. But to-day inhabitants shall be given to the ocean and to the firmament;

fishes shall cleave to the waters, and the air shall be made vocal with the music of the feathered race.

We have before observed that the creation was not only a progressive, but an *ascending* work; each successive stage introducing not simply something additional, but something higher in its nature and character. First we have the creation of matter; second the aggregation and crystallization of matter into various rocks and minerals, exhibiting in beautiful forms and order the arrangement of the particles composing them; next comes vegetable organization endowed with a series of functions, operating in a most wonderful manner to promote the growth of the individual, and to secure the reproduction and continuance of the species; and now, we are carried forward and upward to what is far in advance of all this, namely, to *animal organization*, to creatures possessing the properties of sensation, perception and passion, and acting consciously and voluntarily to attain still higher ends. Here we are brought to contemplate a new principle in creation, that of animal life and its functions—a principle full of interest, but at the same time full of mystery. "Every effort to penetrate into the mysterious temple of life in order to lay bare its principle has utterly failed, and the greatest philosopher approaches no nearer than the crowd." The living principle God has reserved as a secret with Himself. From Him and with Him alone are "the issues of life." We must, therefore, be content to be

ignorant of it, if not for ever, at least during the present twilight of our existence.

In tracing the history of the preceding day, we have seen how "the heavens declare the glory of God;" and in this, and that which follows, we shall discover how that the earth also is full of the riches of His wisdom and goodness. Splendid as are the monuments of the Divine power and wisdom displayed throughout the firmament, in objects fitted by their stupendous magnitude and distances to impress the imagination, and overpower us by their awful grandeur; no less impressive (though in a different way,) nor less replete with wonder, are the manifestations of these attributes in those smaller productions of His hands—*the Living Tenants of our globe*—which, being more on a level with our senses, and more within the reach of our comprehension, are peculiarly calculated to convince the mind, and affect the heart with a sense of the Divine presence and agency. Here we behold scenes of wonder and enchantment, not dimly or at a distance, like the planets and stars of heaven, but plainly and within the reach of close inspection and study. Here meet the eye, not objects of mere lifeless matter, but animated and sentient beings, free and conscious in the exercise of their powers, disporting in their native elements, revelling in the bliss of existence, and by their incessant gambols and exuberance of joy, plainly proclaiming the praises of Him, who, by His breath, created them, and by His providence cares and provides for them all.

And God said, Let the waters bring forth abundantly the moving creature that hath life. A more literal, and, perhaps, a more correct rendering would have been, *the rapidly multiplying creature;* the term is applied in the original Scriptures to all kinds of animals remarkable for fecundity, which, as we know, is eminently the case with fishes and birds.

And fowl that may fly above the earth. The correct translation is, not fowl, but *flying thing;* so that the original term includes all living creatures that can raise themselves into the air by means of wings, insects as well as birds.

And God created great whales. The Hebrew word denotes not only the larger inhabitants of the deep, but also great reptiles, and amphibious beasts.

And the waters brought forth the living creature that moveth after his kind, and every winged fowl after his kind. Hence it appears that fowls, as well as fishes, were made out of the water. Sprung thus from the same element, they each move as it were in an ocean of their own, and by the aid of similar, though not the same means. The operations of flying and swimming are strikingly analogous. The fish may be said to *fly* in the water, and the bird to *swim* in the air. The feathers of the bird answer to the scales of the fish; and the wings of the former to the fins of the latter; while the tail in both serves for a rudder, by which each steers itself through the waves of its own element.

And God blessed them, and said, Be fruitful and

multiply. That is, God gave them power to propagate their several species by generation, and thus to increase into a countless multitude. And it is in virtue of this blessing of God that all the animated tribes of the earth, air, and sea, have continued to multiply and increase to the present day.

Water is pre-eminently the seat of life. No part of the surface of our planet is more fully peopled, or inhabited by greater numbers and diversities of beautiful, or strange, or monstrous forms, than the waters, whether those of the sea, the fresh lakes, the sparkling streams, or the stagnant pools. In every climate from the Northern to the Southern pole water abounds with its living tenants; and from the floor of the ocean, where its depths exceed the heights of our loftiest mountains, up to its ruffled surface, every successive stratum of its waters is crowded with its own orders of life. There is not a bay or a sound, not a rod or a foot of water upon the face of our globe, in which the power of the great Creator is not displayed, and His will executed, by some species of animated beings. The creative fiat of this day passed through all the depths of the sea, extended through all its breadths, and pervaded and animated its every drop.

In the work of the fifth day, we have brought before us for illustration, whales and fishes, birds and insects; or all living things that inhabit the water, and that fly through the air—a field as interesting as it is extensive to every devoted student of God's works.

WHALES.

And God made great whales.

The whale family embraces not only the animals commonly designated by that name, but also the grampus, porpoise, norwhal, dolphin, &c. These are remarkable creatures, as they are, correctly speaking, neither beasts nor fishes, but a connecting link between them. As to their outward form, place of abode, means of locomotion, and habits of life, they are in all particulars like fishes; but their whole internal economy is conducted on a wholly different plan, and nearly, in every respect, closely resembles that of beasts. Like beasts or quadrupeds, they have lungs, liver, spleen, and bladder, and like them, too, they have a heart with its partitions, driving warm and red blood in circulation through the body; they breathe the air, they are viviparous, and suckle their young. Thus all their internal parts bear a close resemblance to land animals, while they live wholly, like fish, in the oceans. It was, therefore, correct and appropriate in Moses to give them, as he does in this day's history, a distinct specification.

These cetaceous animals are the most gigantic with which it has pleased God to people our globe. The hugest inhabitants of the dry land, even the elephant and the rhinoceros, are mere pigmies beside them. The cachalot, or sperm whale, often attains the great

THE WHALE.

length of sixty or seventy feet; while the common whale has been found over a hundred feet long, and two hundred and fifty tons in weight. Every thing about these leviathans of the deep is upon a colossal, and almost appalling scale of magnitude. Dr. Hunter, who dissected a whale, gives an interesting account of its parts and organs. Its spinal column in strength and thickness may be compared to the trunk of a good sized tree, and which, in its thicker parts, is made up of massive vertebral blocks, bound together by the toughest ligaments and cartilages. The main artery is a pipe into which a full grown man might creep with ease; and the heart is an engine of stupendous power and capacity, throwing out from twelve to fifteen gallons of blood at every pulsation. The mouth of the common whale, when distended, is capacious enough to engulf a boat with all its crew; its mere tongue is like a vast feather-bed, on which half a dozen men might find ample room for repose. Equally marvellous is its great strength; its tail is flattened out into a massive plate, which not unfrequently has a surface of a hundred square feet, and with a single stroke of which it can dash the stoutest boat into a mass of fragments, and scatter its daring occupants upon the waters like so many insects. Its motions are extremely powerful and rapid. When confined in shallows it will sometimes leap out of the water, and come down with a force that churns it into foam. And in deep seas, when alarmed or wounded, it has been known to

assume a perpendicular position, with its head downward, and rearing aloft its tremendous tail, lash the water with terrific violence, and then plunge as with one spring to the depth of 4,000 or 5,000 feet—a depth where, according to Captain Scorseby, it has to sustain a pressure of more than 200,000 tons! The tempest, in the hour of its wildest uproar, is its pastime. It plays with the storm-vexed ocean, ascends the crested summits of its mountain waves, then, "like a cradled creature," lies amid their deep and dismal hollows, as if sporting with their rage.

To the whale tribes have been assigned, as their more appropriate habitations, the polar regions of the globe; and very striking are the provisions which adapt them for their cold and frozen homes. The encasement or covering of the whale is of a singular structure; it is like a vastly thick hide loosened and opened into innumerable interstices or cells, which are filled with oily matter called blubber. The blubber thus lodged in the meshes of the skin invests the whale with a covering that is from two to three feet in thickness; and no contrivance can be imagined better calculated to preserve the temperature of a warm-blooded animal exposed to the intense cold of the polar seas. This blubber covering serves also as a float to enable it to swim and even sleep on the surface; while it is of the most essential use to protect it against the enormous pressure to which it is subjected when travelling at great depths.

Some of the whale species live in pairs, and some are gregarious; some are herbiverous, and graze upon the weeds at the bottom of the sea like cattle upon the meadows; others are carnivorous, everywhere pursuing their prey, and often consigning to their capacious stomachs whole shoals of the smaller fishes, such as the *clio borealis*, at a single swallow.

Whales possess the same general senses as land animals. They have the faculty of smelling; and their hearing is acute, even when immersed in the water. Their eyes are so placed that they can see behind as well as before and above, and that for a great distance. They also sleep. Divine goodness has assigned to them, too, their appropriate means and sources of happiness, as they sufficiently attest by their frequent and exuberant gambols. The whale is likewise remarkably faithful to its mate, which returns an attachment that manifests itself even unto death. Parental love is also specially marked in this family. The mother and her calf may be frequently seen disporting themselves together in the water; and when danger appears, the mother either hastily bears its young one off to a safe distance, or defends it bravely against its enemies; and chooses rather to perish with it than to desert her offspring.

REFLECTIONS.

The works of the Lord are perfect, and are all to the praise of His wisdom and power and goodness.

Even the huge frames of these leviathans of the ocean display the perfection of workmanship. Every member and organ, every fibre of the muscles that wield their ponderous bones, every vein and artery concerned in driving the vital fluid through their immense bodies, and every nerve and tissue down to those that can be discerned and examined only by the aid of the microscope, are finished with a delicacy and perfection that are inimitable and unsurpassed. Moreover, in the nature of these, monsters though we call them, the hand of the Creator has planted the same kind and disinterested affection, which ennobles the most exalted of His creatures that tread the solid land, and claim kindred with the skies. And to these instinctive laws of their being they are ever found faithful and constant; so that many of those bearing human form and name, may well go to the inhabitants of the dismal and frozen oceans of the earth, to learn from them the important lessons of conjugal fidelity and parental affection.

FISHES.

Let the waters bring forth abundantly the moving creature that hath life.

Of fishes, properly so called, no less than 8,000 different species have been examined and classified; and many more doubtless remain yet to be discovered. These are of all sizes, from the enormous *white shark*,

weighing 10,000 pounds, and armed with his 200 sharp and frightful teeth, down to the diminutive and harmless *minnow*. They are, moreover, of every shape and structure that can well be imagined. It has been said that the ocean contains representatives of every terrestrial and aerial form; be this as it may, certain it is that the forms of fishes are more singular, grotesque and monstrous than those of any other department of animated nature. Many fishes, however, are creatures of exquisite beauty, both as to form and color. Some glisten with the dazzling brightness of silver; some appear as if encased in burnished gold; and some, as they glide through their native element, reflect all the varied hues of the rainbow. But of whatever form or color these inhabitants of the watery world are found, all are most wisely fashioned for happy existence in the element and locality to which they have been assigned; while every peculiarity of form, and every varied tint or shade in each animal's structure, has been contrived and adopted with a view to some object important to its welfare, or essential to the end of its being.

Had we never known any other living creatures than those of the dry land and open firmament, we should have been settled in the conviction, doubtless, that the functions essential to life could not be performed in such an element as water. To people the ocean would have appeared to us an impossibility. But in this, as in a thousand other things, we see what

is impossible with man is possible with God; and find that He has contrived and fashioned an endless variety of creatures, whose forms and functions and faculties all are every way most happily adapted even to this element. Let us now glance at some of these adaptations; and first at

The *Form* of fishes. The external shape of fishes, in general, is much the same, namely, a sharp oval front, gently swelling in the middle, and then gradually narrowing toward the hind extremity. Now, this is precisely the form, as has been mathematically demonstrated, which encounters the least possible amount of resistance in cleaving the water, and consequently the best for swiftness and ease of locomotion. With such a *form*, and balanced by *fins* exquisitely adjusted to their weight and habits, and buoyed by an *air-bladder*, by the distension or compression of which they can rise or sink at pleasure, and propelled by a *tail* of powerful muscles, fishes are capable of motion, quick or slow, in every possible direction. The velocity and ease of their movements are worthy of all admiration. "Nothing is more graceful and elegant," says Kirby, "than the motions of fishes in their own pure element. Not to mention the shifting radiance of their forms, as they glance in the sunbeams, their extreme flexibility, and the ease with which they glide through the waters, give to their motions a character of facile progress, which has no parallel, unless, perhaps, in the varied flights of the swift-winged swallow. How rapidly do

they glide, and are lost to our sight by a mere stroke of their tail. At another time, less alarmed, how quietly do they suspend themselves, and cease all progressive motion, so that we can discover that they are alive only by the fan-like movement of their pectoral fins, an action which seems in some sort connected with their respiration."

We discover also in the *Covering* of fishes a most happy adaptation to their appointed element. Among land animals we see a great variety of means adopted for their protection, such as hair, feathers, bristles, wool, &c.; but it is obvious that none of these would be suitable for aquatic creatures; their element demands a very different provision. Accordingly, we find fishes clothed in a complete suit of horny scales, each of which is a wonder in itself. These scales are sometimes joined at the edges, presenting exquisite specimens of Mosaic work; but most commonly they are imbricated, or arranged like tiles on the roof of a house, and are covered with a slimy substance, thus forming a perfectly smooth surface, so that the fish can move forward with the utmost ease. Every thing connected with this protecting provision is marked by the most minute and kind care for the welfare of the creature. His coat of mail is quite impervious to the water, and thus, though always immersed in it, he is never wet or chilled.

Another striking adaptation in fishes is their peculiar *Mode of Respiration.* This they perform, not by lungs

like land animals, but by means of gills, which are formed of long pointed plates covered by a tissue of innumerable blood vessels. These plates are arranged like the plumules of a feather, and between them the water is kept in perpetual flow; and from the air mixed in the water is continually extracted the necessary amount of oxygen for the renovation of the blood, which, thus purified, is carried into the heart, whence it is distributed to the whole body. By this extraordinary process, this Divine contrivance, the infinite hosts of fishes are enabled to breathe as easily in the water as we do in the air.

The *Organs of Sight* in fishes present us with another remarkable instance of adaptation. We have already, in speaking of the whale family, noticed the admirable position selected for the eyes of fishes, so as to give them the widest range of vision. We shall now mention several other particulars. The eye of fishes is so constituted that contact with water, even with that of the briny ocean, is no more troublesome to it than that of the air to ours. Again, the eye formed for perfect vision in the *air* is very defective for this end in water. If we make the experiment, we shall find, however good our eyes may be, that we cannot see distinctly in water; but if we put on a pair of convex spectacles, our vision will be at once improved, so that we can discern objects with distinctness even in that element. Now this modification of the sight effected by glasses, has been made by the

Creator Himself in the eyes of fishes, so that they enjoy the advantages of perfect vision. Again, the eyes of fishes, in general, have no lids; yet those species that, like the eel, bury their heads in sand and mud, are covered by the provident care of God by a fine membrane for their protection. But the most singular kind of eye, and that in which the forethought of the Deity is most conspicuous, is that of the *analeps*, a viviparous fish of the rivers of Eastern Asia; the ball of each eye is divided horizontally into two hemispheres by a membranous band, and each half is a perfect organ of vision; the two lower halves are near-sighted, and the two upper long-sighted; and thus the animal is enabled with one pair of pupils to see the little worms below it that form its food, and with the other pair to descry the great fishes, its enemies, while yet at a distance. These are striking facts, indeed; but a microscopical examination of the structure of the eyes of fishes, reveals to us others that are, if possible, still more wonderful. The crystalline lens in the eye of a codfish, which is never half an inch in diameter, has been proved to be made up of more than 5,000,000 of fibres, which are united by more than 62,000,000,000 of teeth!

Fishes appear to be endowed with the *Senses* common to land animals. Those of touch and taste are supposed to be feeble, in general; though some are furnished with flexible feelers, or organs of touch. Their organs of smelling and hearing are more acute,

and are in their structure happily adapted to the element in which they live. These latter senses have no external avenues, as in land animals; for immediate and perpetual contact with the dense element of water would soon prove ruinous to their delicate and sensitive nerves. Smelling is said to be the most acute of all their senses. The olfactory membrane and nerves in them are of remarkable extent; in a large shark they expand over a surface of no less than twelve or thirteen square feet. Hence, by this sense the finny tribes can discover their prey or their enemies at a great distance, and direct their course in the thickest darkness, and amid the most agitated waves.

Possessing the foregoing faculties, fishes are not without a degree of *Sagacity*. They have been found even capable of instruction, and been taught to come when called by their names, and to assemble for their food at the sound of a whistle or bell. They are said to be among the most long-lived of all animals. The carp has been known to reach more than a hundred years of age. And Kirby relates that a pike was taken in 1754, at Kaiserslautern, which had a ring fastened to the gill covers, from which it appeared to have been put into the pond of that castle by order of Frederick II. in 1487—a period of two hundred and sixty-seven years.

Fishes excel in *Strength*, and seem to be capable of prolonged exertion without apparent fatigue. Even the feathered tribe, in this, must yield the palm to the

finny race. The shark will out-travel the eagle, and the salmon will out-strip the swallow in speed. The thunny will dart with the rapidity of an arrow, and the herring will travel for days and weeks at the rate of sixteen miles an hour, without respite or repose. Sharks have been observed to follow and play around a ship through its whole voyage across the Atlantic; and the same fish, when harpooned, has been known to drag a vessel of heavy tonnage at a high speed against wind and tide.

Connected with the *Instincts* and natural *Habits* of fishes are many remarkable facts, but which we can barely mention. Some are herbiverous, and live entirely on aquatic plants; while others are carnivorous, and prey upon weaker tribes. As an illustration of the voracity of the latter class, we may mention, that at a public lecture delivered at Dublin, there was exhibited the skeleton of a frog-fish, two and a half feet in length, in whose stomach the skeleton of a cod two feet long was found. Within the cod were contained two whitings of the ordinary size, while in the stomach of each whiting were found numerous half-digested fishes, which were too small and broken down to admit of preservation. Some fishes are capable of uttering sounds; the gurnards when drawn out of the water will croak oddly. Some can dart out of the water, and, like birds, sustain themselves in short flights through the air with their fins. Various species are wonderfully tenacious of life; the carp may

be kept alive for weeks in wet moss; and the eel, taken and skinned, will leap out of the frying-pan. Some are capable of performing journeys even over land; eels are in the habit of leaving the water in dewy nights, and wander about the fields in search of worms; in China, there is a fish that crosses the meadows at its pleasure from one creek to another, often a quarter of a mile asunder; the flat-head hassar, a fish abounding in Essequibo, when the pools in which they live dry up, will resolutely march in droves over dry land in search of others, and using their serrated fins for legs, will push themselves forward as fast as a man ordinarily walks, always taking a direct course for the nearest water, though it may be altogether out of sight. Another species, found in Tranquebar, not only creep upon shore, but even climb the fan-palm, and seek their insect food among its leaves and branches. Very wonderful, indeed, are facts such as these, and most clearly do they prove that when the Creator gave their being to these animals, He foresaw the circumstances in which they would be placed, and mercifully implanted within them an instinct for their guidance, and provided them with the means of escape from the dangers to which they would necessarily be exposed.

Another notable fact in this day's history, and one specially demanding note and illustration, is the *Fecundity* of fishes. *And God blessed them, saying, Be fruitful, and multiply, and fill the waters in the seas.* This "blessing" is to be regarded, not simply as a

solemn word of command, but the imparting of reproducing energies to the varied tribes of the deep. And to see how effective this blessing was, we need but look at the results which followed. Nothing can exceed that "abundance" brought forth. If we attempt to estimate the number of eggs in the roes of various kind of fish, we may be able to form some faint conception of it. The roe of the cod-fish, according to Harmer's estimate, contains 3,686,000 eggs; of the flounder 225,000; of the mackerel 500,000; of the tench 350,000; of the carp 203,000; of the roach 100,000; of the sole nearly 100,000; of the pike 50,000; of the herring, the perch, and the smelt from 20,000 to 30,000. Other species are equally prolific. Such numbers present an idea of fecundity that is truly overwhelming. It must be observed, however, that a large proportion of the eggs deposited are destroyed in various ways; they are eagerly sought after by other fishes, by aquatic birds, and by reptiles, as food; and in the young state, they are pursued and devoured by larger ones of their own species, as well as by those of others. Still the numbers which arrive at maturity surpass all comprehension, as appears from the countless myriads of those that are of gregarious and migratory habits.

Impelled and guided by that mysterious power we call instinct, fishes, at certain seasons, *migrate* and travel in immense droves to seek a suitable place and temperature for the reproduction of their species. Vast

migrations take place from the ocean into all the rivers of the earth; the salmon and others often ascend large streams in great numbers for hundreds and even thousands of miles. Vaster yet by far are the migrations that occur in the ocean from one region to another. The migratory tribes of the sea are very numerous; of these, among the best known is the cod; at spawning time these fish proceed northward, and frequent the shallows of the ocean, such as the Banks of Newfoundland, where they are found in infinite multitudes. The haddock resorts, in like manner, to northern coasts, and has been found in immense shoals of more than twenty miles long and three miles broad. The mackerel also is a migratory tribe; these winter in the Arctic and Antarctic oceans, from whence in the spring they emerge from their hiding places in innumerable myriads, and proceed to more genial seas to deposit their eggs. The thunny travels for the same end *in numbers without number*. But the most notable of all the migratory species are the herrings; these, like many others, pass the winter in high northern latitudes, and, at different times through the summer, proceed southward in search of food, and to deposit their spawn. Some idea of their numbers may be formed from the vast quantities that are taken. Many years since, when the business was prosecuted on a more limited scale than at present, it was reported that on the coast of Norway no less than 20,000,000 were frequently taken at a single fishing; and that the

average capture of the season exceeded 400,000,000. At Gottenberg, 700,000,000 were annually caught. Yet all these millions were but a fraction of the numbers taken by the English, Dutch, and other nations. But all that are taken by all nations, put together, are no more missed from the countless hosts of the ocean than a drop out of the full bucket. Their shoals, says Kirby, consist of millions of myriads, and are many leagues in width, many fathoms in depth, and so dense that the fishes touch each other; and this stream continues to move at a rapid rate past any particular point nearly all summer. If, then, these single groups of a few species that happen to fall under the observation of man be thus numerous, or rather innumerable, it is obvious that the aggregate of all the orders, genera, and species, making up the whole population of the deep, must infinitely transcend all the powers of human enumeration! Hence we see how has been fulfilled in these creatures the great command, which became to them the law of their being, *Be fruitful, and multiply, and fill the waters of the sea.*

In the foregoing facts we observe this striking contrast between the inhabitants of the water and those of the land—that where the latter bring forth *one*, the former produce a *thousand*, or even a *million*. If no check were provided for this extraordinary tendency to increase, even the ocean, vast as it is, would become overstocked; soon there would be in it no room for motion; and in process of time its waters would

become a mass of corruption, that would prove detrimental to the whole globe. Buffon estimated that a pair of herrings, if left undisturbed for twenty years, would produce a progeny whose bulk would equal that of the entire globe! To restrain this rapidity of increase, and to avoid these evils, numerous oceanic tribes have been ordained to prey upon others, especially upon those of the more prolific kind. And this leads us to notice another class of remarkable contrivances, namely,

The means of attack and defence with which fishes are provided. These are as various as they are wonderful. The most common instruments of assault are *teeth*, and the most general means of escape is *superior speed*. The mouths of many, and even the tongues of some of the great monsters of the deep, are literally planted with teeth; so that whatever happens in anywise to come between them stands but a slight chance of escape. Some elude their enemies and decoy their victims by stratagems so ingenious, as almost to indicate reflection and contrivance; and thus they effect by cunning what they could never accomplish by pursuit. The fish vulgarly called the *Sea-devil*, often six or seven feet long, possessing neither force of limbs, nor celerity in swimming, buries itself in the mud or covers itself with seaweed, and lets no part of itself be perceived but the extremity of the filaments that fringe its body, which it agitates in different directions, so as to make them appear like worms or other baits; little

fishes, attracted by this apparent prey, approach, and in an instant they are caught, and go down alive into its enormous throat. Other species are armed as with spears and swords; the norwhal is furnished with a most formidable nasal horn, projecting from the upper jaw to the length of ten or twelve feet, and of four inches diameter at the base; this is wreathed in a curious and beautiful manner as it tapers to a point, and is of a substance much whiter, harder, and heavier, than common ivory. The terrible sword-fish is similarly armed with a long bony snout, exceedingly sharp and strong, with which it transfixes its prey, or whatever offends it; it is the special enemy of the whale, and sometimes, mistaking the hull of a ship for this animal, it will plunge at it with terrible power; in one instance it thus attacked an East-Indiaman with so prodigious a force as to drive its sword completely through the bottom of the ship, and must have sunk it by the leak, had not the animal been killed by the violence of its own exertion, in consequence of which the snout remained imbedded in the ribs of the ship, and no leak of any extent was produced. A fragment of this vessel, with the sword still buried in it, is preserved as a curiosity in the British Museum. Other species again, such as the hag, will dart at larger fishes, and adhere to their sides by creating a vacuum by means of its lips; this effected, there it remains in spite of every struggle, lacerating them with its teeth, and sucking their juices and their blood like the leech;

and when this animal is itself threatened with an attack, it has the power of exuding from its body a certain excrement, which, mixing with the water about it, renders it invisible to its foe. Again, numerous species of fishes are endued with the remarkable power of emitting sudden flashes of light, like the reflection of the full moon; and when many of these enormous creatures swim together, they appear like a vast procession of great lights moving through the waters, and present a singular and most startling spectacle; their phosphoric flashes are supposed to frighten and put to flight their enemies, and, perhaps, to dazzle and bewilder their appointed prey. Other tribes of the watery world are furnished with long snouts, fashioned, not like the blade of a sword or spear, but like the barrel of a gun, through which they shoot drops of liquid at insects and caterpillars they may see near them on the margins of lakes and rivers; and so accurately do they aim that they seldom miss their game. But of all the diversified powers and organs with which fishes have been endowed, either for attack or defence, the most wonderful is the electric battery, with which several species have been furnished, and by means of which they can smite, benumb, and kill other inhabitants of the water. In the torpedo many hundreds of pipes go to constitute its battery, and with which it can inflict an invisible stroke more to be dreaded than the teeth of the shark itself. The gymnotus or electric eel, is a more tremendous assail-

ant still, as its discharges are said to be ten times more powerful than those of the torpedo; even mules and horses adventuring into their waters have often been killed by these animals. They are able to send their electric shocks through the water, and, according to Lacépède, kill smaller animals at the distance of sixteen feet.

REFLECTIONS

We have now surveyed the faculties, organs and powers with which the Creator has seen fit to furnish the inhabitants of the deep, and whereby they are enabled to secure their necessary sustenance, repel their enemies or elude their pursuit, and fitted to keep the aquatic population, of whatever kind, within due and needful limits. And in these faculties and organs, what fertility of resources, what varied inventions and contrivances do we behold! How manifest the Divine wisdom, power and goodness, and how clear the providing and ruling agency of providence, even in all the deep places of the sea! Deficiencies that would seem fatal are compensated by endowments that the mind of man would never have conceived; and difficulties that would appear insurmountable overcome by expedients, which both amaze and confound us as we view them. We see every creature happily adapted to its situation, however desolate or forlorn; and furnished with faculties equal to all the exigencies of his lot, however desperate. While all, *all* that move

through the deep paths of the ocean, whether harmless or destructive, devouring or devoured, glorify their Almighty Author, by doing or by suffering the wise appointments of His will.

CRUSTACEANS.

The great and wide sea, wherein are things creeping innumerable.

Among the living things which the water brought forth abundantly, was a class of creatures which naturalists range under the above term, and which embraces lobsters, crabs, prawns, shrimps, sea-spiders, &c., animals that are encased in hard but articulated shells. Of the crustacean race there exist in the waters a great many hundreds of species, of which we cannot speak in detail. These are creatures of remarkable structure, complicated in form, and covered, not with skin or scales, but with a hard unyielding crust. They are furnished either with three or four pairs of legs, each composed of five joints curiously hinged together. In addition to these, some of the species have a pair of powerful claws, resembling the finger and thumb pressed together, for seizing and conveying food to their mouths. Many of them are also possessed of a greater or less number of long and slender feelers. They are, in general, creatures of active habits, keen vision, and acute powers of smelling and taste; and have their peculiar system of nerves, respiration, circulation, and digestion, each presenting, on close

examination, a system of wonders in itself. But here our plan compels us to confine our notice to a single species, the lobster; and this must suffice to convey a general idea of all the rest of this class.

The general form of the lobster is that indicated above. It has four pairs of legs; the two anterior pairs are furnished with small pincers at the extremities. Besides all these, it has two claws which are very complicated in their structure, and instruments of great power, holding whatever they seize so firmly that it is impossible to extricate it without breaking the claws. Its antennæ or feelers, which are about as long as its body, consist of long and slender filaments composed of a great number of pieces articulated together. Unlike many species of this family, the lobster is better formed for swimming than walking; its tail is the principal agent used for this purpose, which strikes the water from behind forwards, consequently it can only swim backwards. The tail is very strong, one stroke of which will often carry the animal a distance of twenty or thirty feet. The lobster continues to grow through a good part of its life, and has been known to attain the age of twenty years.

The blessing of fecundity and increase we find was effective in the crustacean, as well as in the other inhabitants of the sea. The lobster produces no less than 12,000 eggs; these it carries concealed and protected under its broad tail. As the temperature increases toward midsummer, small live lobsters are

found among the eggs, of the size of an ant, which remain attached to the fibres of the mother, and are fostered there until all the eggs are hatched. Soon after, they detach themselves from these fibres, and cling to the roots and stems and leaves of marine plants, till they are sufficiently large and strong to abandon themselves to the waves.

The solid casing of the lobster does not admit of increase or extension, so that in order to allow of the growth of its body and limbs, it is necessary that it be cast off, and exchanged for a new shell of larger dimensions. This is done annually, and is among the most wonderful of all the processes observed in the animal kingdom. Toward the end of spring, when food is plentiful, the body and limbs begin to expand; "this goes on till at length it is productive of much uneasiness to the animal, which is in consequence prompted to make violent efforts to relieve itself; by this means it generally succeeds in bursting the shell, and then, by dint of repeated struggles, extricates its body and its limbs. The lobster first withdraws its claws, and then its feet, as if it were pulling them out of a pair of boots; the head next throws off its case, together with its antennæ; and the two eyes are disengaged from their horny pedicles. In this operation, not only the complex apparatus of the jaws, but even the horny cuticle and teeth of the stomach are all cast off along with the shell; and last of all, the tail is extricated. But the whole process is not accomplished

without long-continued efforts. Sometimes the legs are lacerated, or even torn off, in the attempt to withdraw them from the shell. But this animal possesses the wonderful power of speedily replacing a lost limb by the production of a new one from the stump."—*Roget.*

After the whole shell is cast off, the lobster suddenly expands, and grows in all its parts full one-fifth of its former dimensions; but it is left a weak and most defenceless creature; its limbs are so soft that they bend like wet paper; still it manages to crawl to some secluded retreat. And here we are called to behold and admire the kind care and provision of the Creator. For some time previous to the moulting, a secretion of materials had been going on, and laid up within the body of the animal, to furnish him with a new suit; these materials are now rapidly distributed over its every part, and within the short period of three days, are hardened into a perfect and complete shell like the former.

REFLECTIONS.

The moulting process in the lobster, and in all the crustacean species, is in all its parts and stages most wonderful, indeed. Here is a little creature, low in the scale of animated nature, taught to lay aside a suit of solid garments, from which it would have puzzled and baffled the intellect of man to extricate it. Here is a provision made prospectively for a new suit—a

provision made to meet a necessity which the creature as yet neither feels nor foresees. Here is a suit of gelatinous and calcareous armour promptly fabricated, hardened and polished, after profound chemical principles, yet without the least knowledge of that science! Have we not here, then, the most convincing of evidences that the hand of God is concerned in all this, and that He is present even with every living thing that moveth through the deep places of the sea?

MOLLUSCANS.

And God created every living creature that moveth, which the waters brought forth abundantly.

The term *molluscan* is derived from the Latin word *mollis*, soft, and under it are classified an infinite host of soft-bodied animals, encased more or less completely in hard calcareous shells. These all are to be reckoned among the creations of the fifth day; like fishes, they were produced out of the water, and in the water they find their appropriate abode. Of shell-animals more than 11,000 different species have been discovered and examined; and yet this number, doubtless, is but a part of what the great ocean contains; for not only its shores and shallows, but even the floor of its greatest depths throughout, are paved with them. The living tenants of these shells seem to be endlessly diversified as to their sizes, forms, faculties and habits; while all present most interesting subjects of study to the pious

student, as so many displays of the wisdom and power and goodness of the Great Creator.

The shells themselves are objects of rare interest. Their forms and organizations are truly wonderful. Their colors, too, are often so intensely vivid, so richly disposed, and so fancifully variegated, that as objects of beauty they rival many of the most esteemed productions of the vegetable kingdom. In some instances, they closely resemble the work of art; the beautiful *music shell* has the five lines and dotted notes, as if the sirens had written upon it the music which constantly sounds within. In their outlines and configurations they exhibit an endless variety. Some are shaped like a cup or tube; some appear in the form of cones, and spires, and columns; and others present the most graceful and delicate convolutions, and the most complicated articulations.

Shell-fishes are distinguished as *univalve*, *bivalve*, and *multivalve*, according to the number of pieces that compose their shells. In some species, there are male and female shells; in others, both sexes are inclosed in the same shell; while in others still, the two sexes are united in the same individual. Some are oviparous; and some are viviparous, their offspring are brought forth encased complete in their tiny shells. Some families are herbiverous, and may be seen grazing in large droves; others are predaceous, and watch and seize their victims. Some travel about, and some remain fixed to the same spot while they live. So

manifold are the works of God even in this low province of animated nature.

The univalve class are the most numerous of shell-fishes, and exhibit the greatest variety of forms. In general, they are more or less regularly of a spiral structure. Among the most curious of these are the *murex*, so highly valued by the ancients for its purple dye; the *volute* or mitre, including those fine polished spiral shells, which so often ornament the chimney-piece, sometimes embellished with dots, and at other times with bands of various hues; the *strombus*, comprising the larger shells appropriated to the same purpose, spiral like the volute, but with a large expanding lip spreading into a groove, and projecting into lobes; the *cowries*, which have long been known and admired for their beauty and polish, and which form the current coin in many parts of Africa, and in several of the Asiatic Islands; but the most beautiful of all this class of shells, and one of the rarest known, is the *carinaria vitrea*, which is of extreme delicacy and fragility, and nearly as transparent as glass, its owner is a sailor, and in it often skims along the surface of the deep. This, however, is not the only univalve that is capable of navigating the sea. The *violet snails*, as they are called, when the sea is calm, may frequently be seen collected in large bands, swimming gayly and happily together. The *hyalœa* genus will do the same, and when its beautifully colored little sails are expanded, it moves with great velocity, like a

butterfly on the surface of the sea. But the most celebrated of all in this respect is the *nautilus;* the shell of this little animal is lined with a layer of a most beautiful pearly gloss, and in the East is manufactured into drinking cups; the nautilus has eight arms, two of which are furnished at the extremities with a thin oval membrane, which it can at pleasure raise and expand to the gale, while the other six stretch over the sides of the shell, and are used as oars. Impelled by the breeze, this little animal in its tender bark has the appearance of a vessel under sail, and glides with ease and grace along the surface of the deep; when danger appears, it instantly furls its sail, catches in all its oars, turns its shell mouth downward, and by letting a little water into its hold, sinks into the safer and more tranquil regions beneath the surface.

The bivalves are found to be headless creatures, and destitute of the senses of sight, hearing and smelling; they are furnished, however, with gills, heart and nerves. To many of them has also been given one soft fleshy foot, which they can thrust out between their shells at pleasure, for the performance of a variety of operations; by means of this humble, and what we would call a very imperfect instrument, they can turn and hop about, spin their cords, plaster their homes, dig into the sand, and even bore the solid rock. Of this tribe none are more beautiful, both as to its sculptured form and exquisite coloring, than what are called *escallop shells.* The most useful of bivalves,

though among the rudest in appearance, is the *oyster;* this gift of providence is widely dispersed, being found on the coasts of Europe, Asia, Africa and America; and in these creatures, as in other inhabitants of the deep, we meet with a striking exhibition of the original blessing of fecundity, for a single oyster, according to Poli, contains no less than 1,200,000 eggs! But the most highly prized of all this class is the *pearl oyster*, which is found in its greatest perfection on the coast of Ceylon, and in the Gulf of Persia; the internal lining of these shells is a very beautiful substance, and known by the name "mother of pearls;" the pearls themselves are roundish bodies from the size of a large pea downwards, valued according to their size and perfection of form, and are either attached to the shells, or loose between them; they are sometimes so numerous that the animal cannot shut his shell, and so perishes.

Another rare and singular bivalve is the *singing mussel.* The melancholy but soothing music of this little creature may frequently be heard on the coasts of Ceylon on calm moon-light nights. At first it steals upon the ear faint as the evening zephyr over the strings of an Æolian harp, but soon it increases in loudness and sweetness, then changes into the same low tones again, and at last dies away at intervals, to be renewed as before; thus vividly reminding one of the classic fable of the sea-nymphs and their powerful charms.

THE CUTTLE FISH.

Bivalves are of all sizes from the *giant clamp shell*, which has been found four feet in diameter, weighing over five hundred pounds, and containing an occupant large enough to furnish one hundred and twenty men with a full meal—downward to those which are too minute for inspection by the unassisted eye, and which may be counted by the hundreds and thousands within the space of a single cubic inch, yet each beautiful and perfect after its kind, but which space forbids us even to name.

With the molluscan order of animals are generally classed the *cuttle-fish*, *octopos*, *loligo*, &c., a most remarkable family, both as to their outward form and internal organization. The cuttle-fish, indeed, is one of the most wonderful of the works of God. It has a head furnished with very perfect organs of respiration. It possesses the faculties of sight, hearing and smelling. Its jaws are like the bill of a parrot, and from which its food passes into a triturating gizzard. And what is still more remarkable, its circulation is carried on by three distinct hearts instead of one. Its mouth is surrounded by no less than eight long fleshy arms, capable of bending in every direction with the utmost vigor and activity; their surfaces are furnished with numerous suckers, by which they can fix themselves strongly to anything they wish to lay hold of; with these arms it can walk, or swim, or anchor itself safely to the rocks during tempests. Its jaws are of great power, and readily crush lobsters, crabs, and even

shell-fish. By means of the suckers on its arms, it lays such fast hold on its prey as to deprive them of all power of motion; and thus it masters creatures much larger than itself. Its eyes are large and prominent, resembling those of quadrupeds, and carrying in them an aspect of ferocity that strikes terror into every animal it pursues. In the Indian seas, the cuttle-fish attains formidable proportions, and its tentacles grow to a great length; in consequence of which the Islanders, it is said, rarely venture to sea without hatchets in their boats, to cut off these cold and monstrous arms, should the animal attempt to fasten upon them and drag them under water.

REFLECTIONS.

The mathematical principles involved in the structure of the foregoing shells are worthy of special notice. Conchologists have shown that the size of the whorls, and the distance between two contiguous whorls, in turbinated and discoid shells, follow a geometrical progression; and the spiral formed is the logarithmic, of which it is a property, that it has everywhere the same geometrical curvature, and is the only curve, except the circle, which possesses this property. Following this law, the animal winds its dwelling in a uniform direction through the space round its axis. There is thus traced in the shell the application of properties of a geometrical curve to a mechanical purpose. With "these aquatic molluscs, the shell is not

only to be a habitation for the indwelling animal, but also a float; and this it becomes, by the portion of the narrower extremity of its chamber left unoccupied. But in order to preserve its buoyancy, and enable the animal to ascend and descend the water at will, it is necessary that the increment of the capacity of its float should bear a constant ratio to the corresponding increment of its body—a ratio which always assigns a greater amount to the increment of the shell than to the corresponding increment of the animal bulk. Now, it is in accordance with the geometrical character of the form assumed, that the capacity of the shell and the dimensions of the animal do increase in a constant ratio, causing the whole bulk of the animal to bear a relation of constantly increasing inequality to the whole capacity of the shell."* Such is the marvellous process of shell-building—a process carried on daily at ten thousand points along the coasts of every continent and island on the globe. Now, to whom shall we ascribe these profound mathematical operations conducted in the waters of every ocean? To the sightless and brainless little jelly creatures within, or to the only wise God?

* McCosh's Typical Forms, p. 65.

ANIMALCULES.

How manifold are thy works, in wisdom hast thou made them all.

The waters of the earth—oceans, lakes, streams and pools—abound with living creatures of various kinds, too minute in their dimensions to be traced or examined by the unassisted eye. Beyond, and far beyond the limits of natural vision, the microscope has revealed to us new races, and, indeed, new systems of races, whose existence, had it not been for that instrument, could scarcely have been suspected, and whose functions must have remained entirely unknown. When by means of this help we explore this region of animated nature, we feel as if we were entering the confines of a new world, and surveying new orders of sentient existences. Here we behold animals, minute indeed, but of all shapes and figures—some of them appear like mere vital atoms, some like globes, some like slender ribbons, some like wheels turning on axes, some like double-headed monsters, some like long cylinders, some armed with horns, some contorted like worms, some like long hairs, some like tapering spires, some like graceful cupolas, some like swimming fishes, and some like animated vegetables. Many of them are almost visible to the naked eye, while many others are so small that the breadth of a human hair would cover fifty or one hundred of them. Others still of them are so extremely minute that millions of millions

of them might be contained within the compass of a cubic inch. Hundreds and thousands of square miles of the ocean's bottom are covered with the busy animalcula called *polypi*, which have been the builders of reefs and promontories, and of many of the islands *now* the residence of man. The waters of the Arctic Sea are often discolored by myriads of animalcules called *medusæ;* a cubic foot of this water taken up at random was found to contain no less than 100,000 of these little animals. What, then, must be the numbers contained in many square leagues of water of this character, often witnessed in many regions of the globe. Yet all these minute animals, whether found at the bottom or on the surface of the waters, are furnished with the numerous organs of life, as well as the larger kinds; nor only this, they also give decided evidences of sagacity, volitions, feelings, preferences and attachments, like superior animals; and like them, too, they display symptoms of hatred and affection, restlessness and contentment, pleasure and suffering. But let us notice a few particular examples.

The little animal called *proteus* can change his figure at pleasure, being sometimes extended to an immoderate length, and then contracted to a point; one moment we see it inflated into a sphere, the next completely flaccid; and then various eminences like horns will project themselves from its surface, altering it apparently into an entirely different animal. The *rotifera* may be dried up and laid on a shelf, so that

the functions of life shall be suspended for years, and yet when restored to their native element, will revive and be as active as ever.

The *hydra*, a fresh-water animalcule, consists of nothing but a stomach, with little tentacula to draw in its prey; it eats ravenously when it can get food, and yet can live four months without any. When it is turned inside out, it lives on and flourishes as if nothing had happened. But the most remarkable thing about the hydra is its power of repairing almost any injury it may receive that does not absolutely annihilate it. If it is divided lengthwise into several strips, each strip within twenty-four hours will be a perfect animal with stomach and tentacula complete, ready to eat, drink and be merry. Or, by cutting up several hydras, different parts may be made to grow together, and become one animal. And in this way every variety of monster, which fancy yet has feigned, or fear conceived, may be formed.

The *hair-like animalcula* move in armies; sometimes marching in solid phalanx, sometimes dividing into several columns, without confusion or disorder, as if well drilled, and under the direction of experienced commanders.

The most minute of animalcules are called *Infusoria*. Among these the splendid discoveries of Ehrenberg have disclosed a world of wonders. He has described no less than a thousand different species of them. The smallest of these animals are not more than one-forty-

thousandth part of an inch in diameter; and so thickly are they sometimes crowded together that one drop contains 500,000,000 of them! Formerly, it was supposed that these animals were little more than simple particles of matter endowed with vitality. But this distinguished naturalist has ascertained that some of these are herbivorous and some carnivorous animals, that some have shells and some have none; and that they possess mouths, teeth, stomachs, muscles, nerves, glands, eyes—in short, all the important organs of the larger animals. Some species have from 100 to 200 sacks or stomachs connected with an intestinal canal; and the thickness of the membranes that line these stomachs he estimates at one-fifty-millionth part of an inch.

The variety and vigor of the movements of animalcules are especially to be admired. There is scarcely a known means of impulsion or progression that is not to be found in the microscopic world. Some move with graceful undulations like serpents, others dart as if by a spring or elastic force; others move by means of vibrating celiæ, while the charming *vorticellæ* have a rotary motion. The *rotifera*, again, have what seem like two little wheels on each side, which appear to propel precisely as do the paddle wheels of steamers. Others drag their unwieldy bodies along with painful exertion, and others again persist in perpetual rest.

It has also been discovered that the Creator's blessing of fruitfulness was effectual, and is still legible in

the constitution and history of these invisible animalcules, as in those larger inhabitants of the deep. An individual of the *hydatina senta* has increased in ten days to 1,000,000; in eleven days to 4,000,000; and in twelve days to 16,000,000! Even this, however, is but a moderate increase compared with that of another species, which is capable of multiplying in four days to 170,000,000,000,000! This is marvellous fecundity indeed. And the *modes* of reproduction in these minute animals are scarcely less wonderful. While various species among them reproduce by eggs and spawn, like larger creatures, multitudes of them perpetuate their kind in ways totally different from those of superior races. Some multiply by numerous gemmules or buds sprouting from the outer surface of the parent, which gradually develop into its own form, then become detached, and assume an independent existence. Some spontaneously divide into two, four, eight, or sixteen parts, each part becoming a perfect animal like the undivided original, and leaving it impossible to decide which is the parent, or which is the offspring. Some gradually distend like little globules, and presently burst and perish as out of them crawl hundreds and thousands of infant animalcules. Some separate into a number of globular parts, each globule retaining all the vitality and activity of the original whole, and thus the life of the parent knows no end, and that of the offspring no beginning; thus presenting a pseudo immortality. And what is still more surprising, the

same individual, as it would appear, often reproduces in two, three, or four different ways.

REFLECTIONS.

What scenes of wonder have we in the world of animalcula—among creatures whose minuteness transcends all the powers of the imagination, 500,000,000 finding an ample ocean in a single drop of water! And when we are compelled to believe that these are as diverse in their forms and characters as are the larger species of creation; that every one is an organized and living being, with a complex system of members, each of which is most skilfully fitted for its peculiar functions; that the processes of digestion, nutrition and reproduction are carried on in these invisible particles with equal perfection as in our own bodies; that they have instincts and habits, the powers of choice and aversion, and capacity for pain and enjoyment—all this appears so amazing that we find it as difficult to stretch our imagination downwards to the infinitely little among the creations of the earth, as it is to rise to the comprehension of the infinitely vast among the orbs and the systems of the heavens.

Where, then, are the bounds of Jehovah's empire! Where are the limits of the operations of His hands! Man, with striking fitness, has been described as a

> "Distinguished link in being's endless chain,
> Midway from nothing to the Deity."

He looks through the telescope, and discovers the

creations of the Almighty reaching above him to the infinitude of space; he peers through the microscope, and sees them in like manner descending below him to the infinitude of minuteness. Striking and beautiful is the language of the eloquent Chalmers, as he contemplated the respective discoveries made by these two instruments: "The one led me to see a system in every star; the other leads me to see a world in every atom. The one taught me that this mighty globe, with the whole burden of its people and of its countries, is but a grain of sand on the high field of immensity; the other teaches me, that every grain of sand may harbor within it the tribes and the families of a busy population. The one told me of the insignificance of the world I tread upon; the other redeems it from all its insignificance, for, it tells me that in the leaves of every forest, and in the flowers of every garden, and in the waters of every rivulet, there are worlds teeming with life, and numberless as are the glories of the firmament. The one has suggested to me that, beyond and above all that is visible to man, there may be fields of creation which sweep immeasurably along, and carry the impress of the Almighty's hand to the remotest scenes of the universe; the other suggests to me that, within and beyond all that minuteness which the aided eye of man has been enabled to explore, there may be a region of invisibles; and that, could we draw aside the mysterious curtain which shrouds it from our senses, we might there see a theatre of as

many wonders as astronomy has unfolded, a universe within the compass of a point so small, as to elude all the powers of the microscope, but where the wonder-working God finds room for the exercise of all His attributes, where He can raise another mechanism of worlds, and fill and animate them all with the evidences of His glory."

THE WONDERS AND SPLENDORS OF OCEAN LIFE.

In the survey now taken of the watery world—travelling down, as we have, from the enormous whale of a hundred feet length, by its numerous congener monsters of the deep, and through all the unnumbered and innumerable shoals of the migratory tribes, and among the scattered multitudes of encrusted and crawling creatures along the ocean floor, and over the boundless pavements of shell-fish of every varied form and size, together with a thousand other species, till we reach the myriad tribes of animalcula, 500,000 times less than the least visible point—what a distance have we travelled, what a lengthy and diversified series of living beings have we traced! And yet all these are fashioned after their kind in a manner worthy their Divine Maker; each species, from the greatest to the least, embraces a system of exquisite contrivances and adaptations, a combination of faculties and functions, surpassing all human study and comprehension. What, then, shall we think of that All-comprehending INTEL-

LIGENCE that planned and formed all the thousands and tens of thousands of the ocean's differing tribes—differing in size and form and color; differing in the structure of their bones, and in the tissue of their flesh; differing in their organs and faculties and dispositions; differing in their systems of respiration, circulation and digestion; differing in their instincts and habits, food and habitations; differing in their instruments of assault and means of defence, in their modes of reproduction and sources of enjoyment, in the duration of their existence, and the end of their being, as well as in a multitude of other particulars. What an endless diversity do we here behold! What countless organs and functions to be contrived! What innumerable properties and adaptations to be secured! Yet in the DIVINE MIND the whole vast and varied population of the watery world existed in plan, perfect and complete, "when as yet there was none of them." In that plan, nothing was forgotten, nothing overlooked; in its execution, no unforeseen difficulty arose, no living thing, great or small, came short of its designed perfection. How marvellous the arrangements, how perfect the works of the great Creator! Of all, and of each of the inhabitants of the deep and wide sea, it may be truly asserted that

"The minutest throb,
Which through their frame diffuses
The slightest, faintest motion,
Is fixed and indispensable
As the majestic laws
That rule yon rolling orbs."

The world of waters presents us with not only displays of the contriving wisdom, but also with clear proofs of *the universal and unceasing agency* of the Creator. The instinctive doings and movements of the inhabitants of the deep prove that God immediately and unremittingly guides and actuates every one of them. The evidence of this is plain and conclusive. Here we see numerous species migrate from one region of the ocean to another; from year to year they commence and end their long voyages just at such a date, yet without any calendar of the months or reckoning of the days; and they steer through the deep by day and by night, in the storm and in the sunshine, for thousands of miles, taking no observation of sun or moon or stars, without chart or compass, and never once deviate from their course, or miss of their intended destination. We observe others forsaking their failing pools, and marching in a direct line over land for the nearest other water, though they had never seen it. We discover others practising stratagems to decoy and catch their prey, or to elude and escape their enemies, which all the reason and cunning of man could not excel. We behold others still, without experience and without instruction, converting their little shells into boats, hoisting their sails, or plying their tiny oars, and thus sail over the surface of the deep, as safely as the most expert of human mariners. And we find even each of the millions of millions of corallines and madrepores, in the Southern

ocean, building its structure with the most consummate art, depositing one stony particle after another as regularly and correctly as if it worked by compass and rule, until the completed fabric stands before us *a very perfection* of accuracy, symmetry and beauty. Now, in these, and a thousand other operations of a similar nature, we have obviously the presence of *intelligence*, and of a very high degree of intelligence. And the great question is, whose intelligence? Certainly not the intelligence of the animal; for here are operations involving scientific qualifications, which imply a knowledge that man has only attained by the most difficult and gradual mental process; a fact that at once precludes the idea that the directing intelligence is that of the animal. Besides, the mental power here seen displays itself at once in the young progeny, in such full and exquisite perfection, and with such unerring success accomplishes ends, which the animal can neither appreciate nor foresee. If we cannot, therefore, accredit the animal with the wisdom of the means, or with the skill of the operations before us, are we not carried directly upward to the Divine Intelligence, working in and through the animal? Or, to simplify and abbreviate our syllogism—we have in these instinctive doings a mental process of a very high order; we must, therefore, find a mental agent. Such an agent we do not find in the animal; it appears, on the contrary, from all evidence, to be a mere blind instrument. We are forced, therefore, to

admit a higher agent; and this agent can only be the Supreme Intelligence, everywhere present in creation. Thus, then, we are led to the conviction that, all life reveals *a present Deity*, and all the instinctive functions of life the immediate operations of *the Divine energy*. God is not only present with all the myriads of the deep and wide ocean, but actuates and guides them in all their doings. He it is that teaches them their way of life, and acquaints them with their appointed seasons. He it is that sets in order their innumerable armies, and leads them to and fro in their distant migrations. He it is that guides the busy hands of the little polyps in rearing their coral wonders; and that marshals in single ranks or solid squadrons the invisible animalcula of the still and silent pool. Hence we may well join in the devout exclamation of the eloquent Fenelon: "O my God, he who does not see thee in thy works, has seen nothing! He who does not confess thy hand in the beautiful productions of this well-ordered world, is a stranger to the best affections of the heart. He exists as though he existed not; and his life is no more than a dream."

The view now taken of the ocean and its living wonders, serves to show that it is *a high and leading design with God, in the creation, to produce and extend happiness*. Accordingly, we find the water as well as the dry land teeming with delighted existence. We see the margins of rivers, lakes, and of the sea itself, abounding with shoals of the fry of fish, and attesting

by their wanton mazes and gratuitous activity, that they are so happy that they know not what to do with themselves. And in the great deeps, and among the larger classes, we observe racing, leaping, and fantastic gambols, which plainly indicate feelings of delight and happiness. Even within the Polar circles, the inhabitants of those dark and icy seas have their peculiar pastimes and pleasures therein. Happiness, from every region of sea and land, ascends million-voiced to the Great Source of being day by day. Such a sense of it is diffused through creation as warms and animates it everywhere with the breath of thanksgiving. It is Nature's song of piety, and ascends from the dark, unfathomed dells and caves of the ocean, as clearly as from the flowery meadows and echoing groves; and is alike from both, new every morning, and fresh every evening. Jars, indeed, mingle in the wide-toned *Te Deum laudamus*, and mar more or less the harmony of the song; but still upward it goes, an all-pervading strain of happiness, in testimony of the love from which it comes, and in which alone it lives.

To appreciate the happiness and splendor of ocean life, we must actually look down and contemplate some of the scenes of beauty and delight which are presented beneath its waters. And for this end, let us first embark with Sir Arthur de Capell Broke, on the *North Sea*. "The ocean's surface is unruffled, and its waters perfectly transparent. Hanging over the gunwale of the boat," says he, "with wonder and delight I gazed

on the slowly moving scene below. Gliding slowly along, we saw far beneath the rugged sides of a mountain rising toward the boat, the base of which, perhaps, was hidden some miles in the great deep below. Though moving on the level surface, it seemed almost as if we were ascending the height under us; and when we passed over its summit, which rose in appearance within a few feet of the boat, and came again to the descent, which on this side was suddenly perpendicular, and overlooking a watery gulf, as we pushed ourselves gently over the last point of it, it seemed as if we had thrown ourselves down this precipice; the illusion, from the crystal clearness of the deep, actually producing a start. Now we came again to a plain, and passed slowly over the submarine forests and meadows, which appeared in the expanse below, inhabited by thousands of animals, to which they afford both food and happy homes—animals unknown to man; and I could sometimes observe large fishes of singular shapes gliding softly through the watery thickets, unconscious of what was moving above them. As we proceeded, the bottom became no longer visible; its fairy scenes gradually faded to the view, and were lost in the dark green depths of the ocean."

Next, let us accompany the philosophic Quatrefages on one of his exploring trips over the waters of the beautiful *Mediterranean*. Such, frequently, are the stillness and transparency of these waters, he tells us,

that as he sails along, he seems to be hanging in mid-space, or looking down like a bird from the air, upon the landscape below. "Strangely formed animals people these submarine regions, and give animation to them. Fishes, sometimes singly, like the sparrows of our streets, or the warblers of our hedges; sometimes uniting in flocks, like starlings or pigeons, roam among the crags, wander through the thickets of the algæ, or disperse and shoot away in all directions, as the shadow of the boat passes over them. Thousands of Zoophytes, with flower-like petals, blossom beneath the tempered rays of the sun; while hosts of mollusca, some encased in stony shells; others, whose unprotected nakedness is compensated by their gorgeous colors or elegant forms, go gliding along; while awkward long-legged sea-spiders run over them in every oblique direction. Other shapes, like lobsters and prawns, gambol among the weeds, or repose under some friendly arch or overhanging tuft. Add to all these a thousand other beings of every varied form, and of every shade of color, all rejoicing in their native element, and possessing all they need or desire."

Cross we now the Atlantic, and join Schopf in his delightful voyage over the *Caribbean Sea*. "In passing over these splendidly adorned grounds," says he, "where marine life shows itself in an endless variety of forms, the boat, suspended over the purest crystal, seems to float in the air, so that a person unaccustomed to the scene easily becomes giddy. On the clear sandy

bottom appear thousands of sea-stars, sea-urchins, molluscs, and fishes of a brilliancy of colors unknown in more temperate climes. Burning red, intense blue, livery green, and golden yellow perpetually vary. The spectator floats over groves of sea-plants, gorgonias, corals, alcyoniums, flabellums, and sponges, that afford no less delight to the eye, and are no less gently agitated by the heaving waters, than the most beautiful garden on earth when a gentle breeze passes through the waving boughs."

We change our point of observation once more, and with Jukes look down upon one of the reefs of the *Pacific*. And what a stirring sight is here before us. "The bottom of the clear waters is overspread with a green carpet of tubiporas and astreas, diversified by more bright-colored miandrinæ and cariophyllæ, swiftly vibrating their rich golden stamina. Over this world beneath, as if to shade it from the sun, rise groves of living coral, branching in fantastic imitations of the shrubs and trees of the land; and the majestic gorgonias and the less lofty isis undulate like the willows and aspens and climbing plants of our own forests. The plumaria sends forth its spirals from one submarine tree to another, just like the grape-vine of the South. Within this submarine paradise, and among these gorgeous productions, we see a diversified world of living inhabitants. Molluscs drag their shells of pearly lustre along these labyrinths; crabs run and hunt here; strange fish rove tranquilly about the

rising stems, while others more beautiful and radiant with metallic greens or crimsons playfully float among the coral branches, like birds among the trees. Here crawl idly over brainstones and madrepores those fine cones and cowries and olives, that form the pride of many an European cabinet. There long ribbon-fish, gleaming like burnished silver, are darting by; while the parrot-fishes, more peaceful, are browsing and nibbling the young tips of the growing weeds." With such a scene before us, we wonder not at the words of Ehrenberg, when he exclaimed, "Where is the paradise of flowers that can rival in variety and beauty these living wonders of the ocean?"

Thus, then, does the ocean with its innumerable tenants, all in their measure endowed both with the capacity and the means of happiness, proclaim aloud the vast profusion of the Divine beneficence: "O Lord, how manifold are thy works; in wisdom hast Thou made them all; the earth is full of thy riches; so also is the great and wide sea, wherein are things creeping innumerable, both small and great beasts. These all wait upon Thee, that Thou mayest give them their meat in due season. That Thou givest them they gather; Thou openest thine hand, and they are filled with good. All thy works praise Thee, O Lord; and thy saints shall bless Thee."

J S Hill
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BIRDS.

And God said, Let the waters bring forth abundantly the fowl that may fly above the earth in the open firmament of heaven.

Birds compose, in many respects, the most interesting class of animated nature. And in their numbers and varieties we see another astonishing display of the riches of Divine invention and creative power. Had man existed, and been asked on the morning of the fifth day, before a bird had been seen or made, how creatures could be contrived that could overcome the force of gravitation, raise and poise themselves high in the atmosphere, and there with ease and rapidity advance or recede, rise or descend, or transport themselves from one region to another with or against the wind, at their pleasure—had such a problem, I say, been then proposed to man, its solution would not only have been altogether beyond his capacity, but he would have pronounced the thing an impossibility. But behold what man could never have conceived God hath done, and done in an endless variety of ways! Nearly 7,000 different species of birds have already been examined and classified; and there can be little doubt but thousands more exist in the unexplored forests, marshes, deserts and mountains of the earth. These are of all forms and sizes, from the formidable condor of the Andes down to the diminutive humming bird that flits in the sunshine of the tropics. Many

of them fill us with admiration by the grace and elegance of their forms, others astonish us with the ease and swiftness of their motions, while others still, delight us no less by the beauty and gorgeousness of their plumage. In a word, the feathered race may be regarded as being altogether the fairest marvels of our world.

Nowhere can *design* and *adaptation* be more conspicuous than in the formation of birds for their native element. Their general shape, being invariably that of a wedge terminating with the sharp apex of the bill, is made to cleave the air with the utmost facility. Again, in order to rise and skim through the impalpable ether, *lightness* was found an essential qualification; accordingly, of all animals, birds are the most lightly built, and the most penetrated by the element in which they move; their bones and their whole organization are filled with air, as a sponge with water; so that they possess a degree of levity that no other class of animals is endowed with. "In birds distinguished for their power of flight," says Child, "such as the Solan-goose, Albatross, and Pelican, the air not only fills the bones, but surrounds the viscera, insinuates itself between the muscles, and buoys up the entire skin; so that the whole body is inflated like a balloon." Add to all this the fact that, the air thus inclosed in the body of a bird is heated by its natural temperature some ten or twelve degrees above that in the body of a man; and this, on the principle of a fire-balloon,

renders the whole bird still more buoyant. Thus, then, with a light body, a sharp beak to cleave the air, a smooth coat of overlapping feathers, terminating in an expansive tail for a rudder, and possessing a pair of vigorous wings, birds are able to move in what direction and at what speed they please; can glide motionless through the air, or skim the surface of the waters; can ascend above the clouds, or alight upon the earth, or even sport with the force and fury of the gale.

A bird inflated, as above described, as is obvious, could no more sink in water than an equal bulk of cork; yet some of the most remarkable for their power of flight are no less distinguished for the facility with which they can dive and glide about under water. And herein we discover a most striking instance of mechanical design. Aquatic fowls, that have been appointed to seek their food in the waters, are furnished with special sets of muscles variously disposed over their frames, by means of which they are enabled to contract the body and immediately expel the air, so that they can as readily dive and chase their prey along the bottoms of rivers and pools as they can skim through the atmosphere. *Contrivance and design* are not more clearly indicated in the valve by which the aeronaut discharges the gas from his balloon in order to descend, than they are in this power given to aquatic birds.

The *covering* given to birds—its lightness, its smooth-

ness, its warmth, its beauty—is worthy of all admiration. What lighter clothing for aerial flights could have been devised? The entire feathers of an owl weigh only an ounce and a half. What warmer protection could have been given to those that spend much of their time on the water than their thick plumage, which they are taught to render impervious to moisture by the application of oil secreted in their bodies for that express purpose? If we look at these feathers one by one, we shall find the simplest of them a production of marvellous ingenuity. Every feather has been measured and weighed, shaped and colored, with reference to its particular situation and function, and the whole presents a striking display of creative wisdom. And if we examine the fine feathers of such birds as the egret, the enu, and the ibis; or the gorgeous ones of the peacock, the parrot, and the bird of paradise; or the more rare and costly plumes of the ostrich and the heron—we are forced to admit that here we trace the hand and pencil of a Divine Artist, whose mind embraces the perfection of all symmetry, beauty and grace.

In the feathered creation, as in every other department of animated nature, we find a most wonderful diversity in form and stature, in instincts and habits. Few things can exceed the variety here displayed. Some are of great size and power, able to bear away on the wing a lamb, a kid, or even a small deer, with ease; others are extremely small and delicate, scarcely ex-

ceeding in size a beetle or a bumble-bee. Some are made to dwell upon the sea, and some upon the land. Some subsist by prey, and some on seeds and grasses. Some roost through the night and are abroad in the day; and some are of habits quite the reverse, remaining secluded in the day time, and roaming about in the night. Some make their homes among the loftiest crags of the mountains, others in the lowest fens and marshes; some in the depths of the forest, and some on the barren heaths or sandy deserts. Some are capacitated to soar among the clouds, and others to dive into the bottom of pools. Some are of a nature wild and untamable, others are domestic and content to dwell about the habitation of man.

But great as is this diversity among the fowls of the air, each is every way happily adapted for the lot assigned to it. The entire structure and each particular organ of birds display the most marked and beneficent adaptation to their several modes of life. Take, for example, the *beak* or *bill*, and we find it in every instance modified and constructed according as its owner is a swimmer, a wader, a courser, a scratcher, a climber, a percher, or a ravener. The little sparrow tribe is appointed to subsist principally on seeds and grain, and to it is given a bill so sharp, and with a point so tempered, that it can readily pick every kind of seed from its concealment in the plant; and not only that, but hull them and obtain the naked kernel. The carnivorous hawk, with its kindred species, is armed with a

hooked beak, with which it can separate the flesh from the bones of the animals upon which it feeds as cleanly as a dissector's knife. The goose, duck, etc., being designed to feed partly on grass, and partly on such substances as they can find in the mud at the bottom of pools, are furnished with a spoon bill, the most suitable that can be imagined for both these purposes. The parrot, a climbing bird, is provided with a beak that curves into a hook, and forms the very instrument by which it is enabled to climb from twig to twig, and branch to branch. The gannet, which feeds upon fish, has the sides of its bill irregularly jagged, that it may hold its slimy victims more securely. The crane is made to live and seek its food among the waters; at first thought, its lot might appear hard, as it is destitute of webbed feet and incapable of swimming; but to make up for this deficiency, it is furnished with long legs for wading, and with a long neck and bill for groping after its food. The woodpecker, which lives chiefly on insects lodged in the bodies of decayed trees, is provided with a bill, straight, and hard, and sharp, to dig and bore down after them; and also with a tongue, which it can thrust out full three inches, which is tipped with a stiff, pointed, bony thorn, barbed like an arrow; having exposed the retreats of the insects by means of its bill, it instantly thrusts out at them this long tongue, transfixes them on the barbed point, and thus draws them within its mouth. Such are a few examples of the striking adaptations observed in the beaks or bills of birds.

Let us again look at the *foot*, and the same thing is equally observable. To aquatic fowls has been given a web foot, so constructed and articulated as to form the most effective propeller for them in the water. But as land birds do not attempt to swim, or adventure to the water, they have received another, and for them, a more suitable foot, viz., a divided one. The vulture, the eagle, and the hawk, birds that prey upon hares, rabbits, mice, etc., are armed with crooked, sharp and powerful claws, with which they seize and hold with unfailing grasp whatever they descend upon. The heron and cormorant have the middle claw, toothed and notched like a saw; these birds are great fishers, and these notches assist them in holding their slippery prey. Here, then, again, we behold adaptations of a most marked character.

Once more: The *internal arrangements* of birds present adaptations corresponding to their natures and habits that are equally striking. Birds that feed on seeds and grain have crops, and here these are moistened and softened, and then pushed on into the gizzard, the inner coat of which is filled up with rough plates, which, by a strong friction against one another, readily break up and grind their food into uniform pulp. In birds of prey, we find a membranous stomach, and a gastric juice, capable of dissolving rapidly and effectually any animal substance they may swallow. Their food need not be masticated by teeth, or ground by a gizzard, consequently they have neither the one nor the

other. The gizzard is an organ of great power; that of some mollusc-feeding birds is strong enough to crush and grind the shells with ease. Thus Infinite Wisdom has adapted every fowl of the air for its appointed place and lot; purpose and design are manifest in all.

Birds excel in *muscular power*. The promptitude, force and activity they display in their movements, and the unwearied vigor with which they persevere for hours and days, in the violent exertions required for flight, far exceed those of any quadrupeds. The little wagtail seems incapable of rest, and insusceptible of fatigue, being perpetually in motion. The ostrich will outrun the fleetest horse. The condor, Humboldt informs us, soars to the height of Chimborazo; and to see him with expanded wings, wheeling round its summits, or sweeping down in graceful gyrations from the upper sky, each circle contracting as the earth is neared, is represented by travellers as a sublime and imposing sight. The wild pigeon will fly for a whole day at the rate of sixty miles an hour. It is a matter of history, that a falcon belonging to Henry IV., of France, having escaped from Fontainbleau, was found at the end of twenty-four hours at Malta, a distance of 1350 miles. The speed of the swallow is computed at 90 miles per hour. The albatros, the largest of the sea birds, and having wings that sometimes expand to the extent of nearly twenty feet, will fly with a velocity of 100 miles an hour. It is said that the little bird called *swift* darts through the air at a velocity of not less than 180 miles per hour. But

no bird, perhaps, compares all in all, as to flight, with the eaglet of the sea, or frigate-bird. With a comparatively small body, and a pair of prodigious wings, often sixteen feet from tip to tip, this bird can afford to despise the most powerful tyrants of the air—can in an instant leave even the condor leagues behind it. If a storm comes, it ascends to heights where all is calm, and hovers in royal solitude at an elevation of 10,000 feet. In its descent, if perchance it meets with other birds that are fishing, and that have lifted their fish out of the water, it attacks them, makes them disgorge their prey, and catches it ere it reaches the surface of the deep. "If it seriously wishes to travel," says an enthusiastic French naturalist, "all distance disappears. It can breakfast in Africa, and dine in America. Or if it wishes to take it more leisurely, and to amuse itself on the way, it can do so; it can lay by for the night, reposing on its great motionless wings, and literally sleep on the bosom of the wind."

Bernouilli once challenged the mathematicians of Europe to solve a famous problem: it was, *To determine the line through which a falliny body would descend most swiftly.* Two, Leibnitz and Sir Isaac Newton, were able to solve it, and proved the line of swiftest descent to be, not a straight line, but a particular curve called the *cycloid.* Now, it is believed that it is by this very swoop that the eagle descends with such astonishing velocity upon its prey. Here, then, neither the writer nor the reader can escape the

question, Who taught the birds of the mountains the line of swiftest descent, the discovery of which was believed to be a test of the highest mathematical skill?

In birds, the organs of *sight*, *hearing*, and *smelling* are in general of great acuteness, and admirably adapted to their several wants and habits. The eyes of owls, and other birds of night, are expressly constructed for seeing amid faint and scattered rays of light; whilst those of day-birds are obviously different according to their different habits. The eye in birds generally is proportionally larger and more prominent than in other animals; which enables them to command a more extensive range of view. Many tribes possess, in a wonderful degree, the power of altering the focus of vision, so as to see with equal distinctness objects that are nearer or more remote. A wild pigeon, flying at double the rate of a railroad car, can inspect the face of the ground below, and discover its food with facility. The vultures of Africa will discover a dead animal as soon as it falls, from heights utterly viewless to the human eye. The hearing and smelling in many species are equally acute. The organs of hearing in birds are of larger size compared with that of the head than in other animals. And the size of the olfactory nerves in birds of prey greatly exceeds that of the same nerves in granivorous birds.

Although the brain of birds is far less fully developed than that of quadrupeds, yet in point of *intelligence*, they are scarce inferior to them. Some

are as capable as the dog of being trained to many things, and give decided evidences of aversion and attachment, memory and expectation. Dr. Schinz had a couple of tame storks that knew their names as well as a dog, and on being called would immediately come to him; they would by their gestures urge him to shake down the cockchafers from the trees for them, and to take the spade and turn the soil, that they might pick up the worms, of which they were very fond.

Even the goose, though long slanderously made a proverbial expression for silliness, possesses a marked degree of intelligence. A flock of these birds never yield themselves to slumber without appointing a sentinel, and that sentinel, to ensure wakefulness, stands invariably on one foot. Bishop Stanley mentions a goose that followed its owner about the streets with as much fidelity as a dog; when he entered a house, it would wait patiently outside for his return, and when he reappeared, would express its joy in its own peculiar cries. The same authority also relates the story of an aged blind woman, in Germany, who was habitually led to church by a sagacious old gander. The gander took hold of her dress with his bill, and gently led her along. Having seen her fairly seated in her pew, the fowl decorously withdrew, and cropped for himself a refreshing meal from the rich grass growing around the church. As soon as the services were over, he returned to his charge, and conducted her in the same way home again. He was regarded

by the family as a safe and reliable escort; and they were accustomed to say that they felt no anxiety on the old lady's account "so long as they knew that the gander was with her."

The *memory* of birds, in many instances at least, is surprising; for, after long absence and a voyage of many hundred miles, the migratory species will return not only to the same clime and country, but, with unerring certainty, to their former haunts. "Year after year," says Dr. Hartwig, in his Harmonies of Nature, "the swallow, after revelling in the orange groves of Italy, or among the palms of Africa, revisits the same English cottage, ever ready to welcome it under the same hospitable thatch." The parrot gives numberless proofs of memory and intelligence; he not only imitates the voice of man, but has also a strong desire to do so, which he manifests by his attention in listening, and by the continuous efforts he makes to repeat the phrases he has heard. He seems to impose upon himself a daily task, which even occupies him during sleep, as he speaks in his dreams. Le Vaillant tells us that he heard a parrot repeat the Lord's prayer from beginning to end in the Dutch language.

The Rev. Mr. Jenyns relates that he knew a tame owl, which was so fond of music, that he would enter the drawing-room of an evening, and, perching on the shoulder of one of the children, listen with great attention to the tones of the piano forte; holding his head first on one side, then on the other, after the

manner of connoisseurs. One night, suddenly spreading his wings, as if unable to endure his rapture any longer, he alighted on the keys, and driving away the fingers of the performer with his beak, began to hop about upon the keys himself, apparently greatly delighted with his own execution.

Of all animals, birds are the best organized as to *voice*, or the power of uttering sounds. The windpipe in birds is very large and strong; the larynx, unlike that of man, is double, one being at the top, and the other at the bottom of that pipe. The sound produced in the lower larynx is further modulated in passing through the upper, so that by means of the two they are capable of uttering nearly all possible variations of sounds. The air playing through these larynxes is supplied, not from the lungs alone, but also from the air-sacs distributed over the body, with which they stand in free communication; hence it is that they can continue their songs so long without stop or interruption. In different species, these organs of voice are modified to utter such notes, and to speak such a language, as their respective natures and circumstances seem to demand. The cawing of the rook, the croaking of the raven, the cooing of the dove, the carolling of the lark, the warbling of the nightingale and of other singing birds, are all the results of their organization, modified according to the plan and will of the Infinite Intelligence, who created all.

There is something at once peculiar and delightful

in the musical intonations of the feathered race, which affords a clear indication of beneficent and loving design. The music of the grove has always been a favorite theme with the poet; nor is there any grade or class of men to whom the songs of the little warblers among the leaves are not a source of enjoyment. What life and charm do their melodies lend to the beauties of the summer months. With what pleasing emotions do they inspire the heart of the listener. Some delight us with their long and quivering notes, and sweet variations; now gently warbling, then gradually swelling into astonishing force and rapidity. Some, with harsher pipes, arrest our ear with discordant sounds, yet, by their contrast, adding interest to the general concert. Some alternate their liveliest notes with plaintive accents that soothe and melt the soul into pleasing melancholy. Others, with their gay and lively airs, elevate our spirits, enkindle our best and liveliest feelings, and bring our whole intellectual and emotional being into harmony with the peaceful and charming scene around us. But the notes and songs of birds, which are thus so agreeable to us, are probably more delightful, and far more significant, to the respective tribes which give utterance to them. They are to them the language of conjugal affection, of parental love, of triumphant exultation, of social enjoyment. They animate and urge forward the labors of nest-building, they cheer the tedium of incubation, they infuse joy into the hearts of the tender brood, they bid defiance to enemies, and inspire friends with confidence.

The voice of birds is remarkable for its power of penetration. No beast, in proportion to its size, approaches them in this respect. Were even a lion chained to a balloon, his deep roar would be lost in space; while the little lark ascends singing, and is heard when no longer visible. Its little vibrating throat sets the whole atmosphere around into waves or undulations. "Let us suppose that we hear its song when elevated to the height of 500 feet in the air; in that case its voice agitates or undulates a sphere of air 1000 feet in diameter; that is to say, it communicates to 17,888 tons of air a motion sufficiently intense to be appreciated by our organs of hearing."—*Glaciers of the Alps.*

Another fact of very pleasing interest connected with birds is their *pairing.* Early in the spring, almost every little songster of the grove, and meadow, and heath, has chosen a mate. And those that have migrated to spend the winter in distant countries return, each accompanied by its wedded help-meet. And in this relation they are patterns of fidelity, as well as mutual sympathy and kindness. Even the fierce eagle and rapacious hawk are remarkable for their fidelity and love for their respective mates. Ravens and crows generally pair for life. The dove is also distinguished in this respect. "The pigeon devotes herself to one companion, and the union is only dissolved by death; when bereaved, she mourns her loss, and long refuses to accept another mate. The black pigeon of the East,

when her mate dies, obstinately rejects all others, and continues in a widowed state for life. Among thousands of examples, few are, perhaps, more touching than one given by Lord Kaimes, who relates the circumstance of a canary, which fell dead in singing to his mate, while in the act of incubation. The female quitted her nest, and finding him dead, rejected all food, and died by his side."*

In this pairing of birds we discover another striking and beneficent provision of the Great Father of all. In nearly every other order of animals the care and toil of rearing the young devolve entirely upon the female. When the offspring is suckled, there is little that the male can do, and his attentions are not required. But with birds it is not so. Their parental duties are many and tedious and full of labor. They have to build a nest with much skill and toil; the eggs are to be laid, and long brooded on by day and by night; and the young, when hatched, are to be carefully fed and educated. And these are operations that demand the united efforts of both parents. To procure a daily supply for six, eight, or ten, craving mouths, would be more than the poor mother, with all her devoted efforts, could possibly accomplish. "The Creator, therefore, who placed her in these circumstances, has provided for her the means of not only lightening her labors, but of also rendering them delightful. Her faithful and affectionate mate constantly attends her; they build the

* Benedicite.

nest together; by day, while she performs the duty of incubation, he either collects her necessary food and carefully feeds her himself, or occasionally supplies her place on the nest, while she hunts the fields to satisfy her own wants; and when the task is accomplished, he sits on a neighboring bough, and cheers her tedium with a song. By night, the nest is their common resting-place, where they nestle side by side. When the callow brood are hatched, they roam together or apart, to forage for them in the neighboring gardens, or fields, or woods; and urged by parental affection, and warmed by mutual sympathy, they ply their constant toil without remission and without weariness. When at length the first helpless stage of existence is passed, and the young, full-fledged, are to be committed to their own resources, the little patient and affectionate acts with which they united to train their tender charge to the important functions of their being, gracefully crown these varied and tender labors of love."—*Sac. Phil.*

Of all the instinctive operations of the feathered race, not one, perhaps, is more remarkable, more varied, and more worthy of admiration, than their *nest-building.* In this important business, the first point of inquiry with the little artificers is, *where* shall the nest be built. In deciding this, each species is directed by its instinct to select with admirable discernment the locality best suited to its habits and temperament, and the most secure from its particular enemies. Hence the situations chosen are as various as are the natures of the builders.

Some choose the tufted grass, some the clayey bank, some the eaves of houses, some the surface of the sand, some the clefts of the rocks, some the dark and hidden caves; but the great majority nidificate in bushes and trees. As a general rule, the main object aimed at in nest-building seems to be to secure and to preserve a sufficient and equable degree of heat for the eggs during the process of incubation. Hence both the character of the materials, and the care with which they are put together, vary according to the size of the bird, the climate of the country, and the season of the year. Large birds, like the eagle, the emeu, and the osprey, whose great bodies possess in themselves adequate heat without much artificial aid, build carelessly, and with a few rough materials; while the little goldfinch forms the cradle of its young with fine mosses and lichens, made compact as felt, and then lined with thistle down—a model of beautiful construction. The thrush, which breeds very early, plasters its nest with loam, in order to exclude the keen gales of the still lingering winter; whilst the little warbling wren is taught another way, and delays its maternal labors till the middle of summer, to compensate for the trifling degree of warmth communicated by its tiny form. The ostrich, which resides in the hot wilds of Africa, scratches a little hollow, and lays her eggs on the bare sand. In wide and opposing contrast with this, the eider duck, in the chilly regions of Iceland, tears the down from her own body, that, by a lining so soft and warm, she may protect her precious charge from the inclemency of that climate.

The ingenuity exhibited in this work is also very marked and wonderful. The European woodpecker, having, after full examination, selected his tree, cuts out a hole in the solid wood, as circular as if described by a pair of compasses. The direction inclines downward for about six inches, and then straight down for some ten more; within this is roomy, capacious, and as smooth as if the work of a cabinet-maker; but the entrance is judiciously left just so large as to admit the bodies of the owners. During this labor they regularly carry out the chips, often strewing them at a distance to prevent suspicion. But the South American woodpecker, which has to guard against different enemies, the monkeys and the snakes, adopts a very different style of architecture. The chief material employed is a species of moss, resembling hair. This the little bird first fixes by some viscous substance, gathered in the forest, to the most extreme branch of a tree; then building downwards, and still adding fresh materials to those already procured, it forms a nest, which hangs like a pouch from the point of the branch. There it is suspended before the spoilers, a tempting object, which they can only gaze upon, while the little tenants fly in and out without danger or molestation. The little weaver-bird of India takes slender grasses, and so intertwines them as to form a web for its nest of a most wonderful structure. The tailor-bird, however, goes beyond all others both in skill and caution; it picks up a dead leaf, and actually sews it with fine fibres to the

side of a living one, its slender bill being its needle; and this pocket it then lines with feathers, gossamer, and down. Its weight is less than one quarter of an ounce, so that a single leaf is amply sufficient to support both it and its nest.

All birds propagate their species by eggs, and *the number of eggs* laid by each particular kind has been limited by creative wisdom. Birds of prey lay few, and breed slowly; but those preyed upon breed rapidly and in profusion; so that those birds which are intended to restrain within certain bounds, but not exterminate, the smaller tribes, produce very few; while the other orders, in proportion to their helplessness and liability to destruction, produce a far more numerous progeny. By this adjustment the balance of nature is preserved.

The nest finished, and the appointed number of eggs laid, the bird is led by an influence as infallible as that of gravitation, and proceeding from the same source, *to sit upon them for a set length of time.* The operations of instinct throughout the process of incubation are truly marvellous. Nothing can exceed the patience, self-denial, and endurance of the female bird while hatching. The happy freedom, the playful flights, and warbling concerts, to which she has been accustomed, are all cheerfully given up, and for many hours of many days she sits alone upon her secluded nest, and neither cold nor wet, nor even the approach of danger can drive her from it. When at intervals she leaves to seek a little sustenance, quickly and punc-

tually she returns, lest her precious charge should become chilled. With tender caution every egg is covered with her body, and often are they moved and turned, that all may equally partake of the vital heat. A chemical operation, says Addison, could not be followed with greater art or diligence than is seen in hatching the young brood; yet is the process carried on without the least glimmer of thought or common sense. And when at length the young burst their prison cells, and come forth, what tenderness of affection is manifested by the parent birds! How they rejoice over them; how they lull and quiet them by their gentle notes of love; put food into their little open bills; cover them with their feathers and keep them warm; lead them forth and teach them to pick and gather food for themselves; and in a word, "perform the part of so many nurses, deputed by the Sovereign Lord and Preserver of the world to help such young and helpless creatures."

Another fact closely related to the foregoing, and which here demands notice and illustration, is the *fecundity* of birds. *And God blessed them, and said, Be fruitful, and multiply.* In virtue of this blessing, birds, through all their successive generations, have inherited the reproductive energies undiminished, and have increased into multitudes that cannot be numbered; they have overspread and taken possession of every part and portion of the earth's surface. The groves of the tropical and of the temperate regions are

everywhere vocal with their various notes and songs; and even in the arctic and antarctic regions, the ground is often covered for leagues with millions on millions of them. Whole islands are buried beneath their mere excrement to the depth of several feet. Captain Flinders saw a flock of *sooty petrels* pass over him in Van Diemen's Land, which could not have contained less than 150,000,000. And Mr. Audubon estimated that a flock of pigeons that passed over him, on the banks of the Ohio, must have contained *one billion one hundred and fifteen millions!* which would require for their support not less than *eight millions of bushels of grain or seed daily!* And yet all these are but a part, a small part, of the whole feathered family, with which the Creator hath peopled, enlivened, and adorned our world.

One more subject connected with the fowls of the air full of interest and wonder, and which we cannot, therefore, pass by unnoticed, is their *migration.* A very large proportion—considerably more than half—of the different species of birds undertake regularly, at certain seasons of the year, long and distant journeys from one clime or region to another. Thus our little *snow birds,* on the return of warm weather, proceed northward, and spend their summers in the regions of the arctic circle; and as the sun declines there toward autumn, they return again to pass the winter with us as before. The swallows, the nightingales, and the quails, which so much enliven the summers of France

and the British Islands, as the fall of the year approaches, assemble at their appointed time, take their leave, and cross sea and land to spend the winter months on the northern coasts of Africa. In like manner our oriole and bobolink, that charm us with their sweet and varied notes in the sunny days of summer, pass their winters many hundreds of miles nearer the warmer regions of the tropics; whilst our little blue-bird wings his flight across the sea, and makes his winter home in the distant Bermudas. The general intention of these remarkable movements seems to be to secure a supply of food, and often, a suitable temperature for rearing their young. The manner in which these migrations are performed differ in different tribes. Some choose to travel alone, or in single pairs; and some assemble in vast flocks, and take their flight together under appointed leaders. And what is more remarkable still, in some species, the males assemble and depart by themselves, leaving the females to follow them after an interval of some days; while in other species, the females congregate and depart first, leaving their mates to come after a similar interval. Some birds travel by day, some by night, and some press on their way indifferently both day and night; and most seem to pass the whole of their migration without sleep.

REFLECTIONS.

In the preceding pages we have seen that the numbers and varieties of birds are exceeding great; yet upon careful observation and close study, every individual species is found to embrace in its organization contrivances and adaptations, numerous and diversified, that fit it happily and in all respects for its intended place, and to accomplish its appointed ends, in the general system of animated nature. How incomprehensible the wisdom and power of Him, who contrived and executed the innumerable forms and features, and who conceived and bestowed the faculties and endlessly diversified instincts of the whole feathered race, as now scattered over the entire seas and lands of the globe! Ere the creative word had gone forth, and ere the morning of the fifth day had dawned, all potentially and prospectively existed in His all-comprehending mind *as clear and complete* as they now exist in living reality—the peculiarities and characteristics that were to divide them into their several orders, classes, and species; their outward forms and inward constitutions; the locations they were to occupy, and the habits they should follow; the materials they should employ, and the skill they were to exercise in building their nest habitations; the seasons at which they should severally pair, the number of eggs they should lay, and the length of time required for their incubation; the texture, the arrangement, and the coloring of their

plumage; the instincts that should guide them in finding and selecting their food; the artifices they should practice in eluding their enemies, and in catching their prey; the notes they should utter, and the songs they should warble; their individual character, and social dispositions; their passions and affections, pleasures and pastimes; their language or mode of communication with each other; the force and fleetness with which they should fly or swim, dart through the air, or dive into the water; the periods of their longevity, and the degrees of their fecundity; the times at which they should depart and return in their stated migrations; the relations they should sustain and the ends they should subserve in the great system of nature—all these, and a thousand other things connected with them, stood forth clear, perfect, and complete before the omniscient eye of the Creator as He opened His lips to utter the words, *Let the waters bring forth abundantly the fowl that may fly above the earth, in the open firmament of heaven.* In view of such a display of the Divine Capacities, how fitting, Reader, for you and me, the adoring exclamation, "O the depth of the riches both of the wisdom and knowledge of God!"

As in the beauteous creations of the vegetable world, and among the countless living tenants of the deep, so also among the birds of the air, we behold indubitable evidences and most impressive displays of *the universal and constant agency of God.* In all their

doings and movements, the guiding finger of their Creator is clearly seen. Prior to all experience, and independent of all instruction, we see the little feathered tribes undertake and accomplish all the ingenious duties of their being; and accomplish them, too, with a certainty and perfection which no instruction could teach, and no experience improve. The sparrow performs and goes through with the whole wonderful process of building, laying, hatching and rearing, as successfully the first time as the last. And whence is all this to the little bird of the air, if not from the omnipresent and infinite Spirit? Who or what leads the young female bird to prepare a nest, untaught and undirected, long before she has need of it? Who instructs each particular species in its own peculiar style of architecture? And when the first egg is brought forth, who teaches her what she must do with it? or that it is a thing to be taken care of, that it must be laid and preserved in the nest? How comes she to know that her young are contained in the eggs? for certain it is, that there is nothing in the external aspect, or in the internal composition of them, which could lead even the most enlightened and scientific mind, previous to experience, to conjecture that out of them presently would come forth living, perfect birds like herself. And the germ of future life being wrapped in the egg, who teaches its little owner that heat will develop and mature that germ? Who acquaints her with the fact that, her own body pos-

sesses the precise kind and degree of warmth required? And what is it that holds her so constantly and so long upon the nest, amid light and darkness, storm and sunshine, without the least knowledge or idea as to what the result or fruit of all this toil and self-denial is to be? Here, then, are operations carried on, and effects produced, which must constrain every candid mind to recognize in them the invisible hand of God.

Again, the *migration* of birds—how astonishing is all this? "The stork in the heavens knoweth her appointed times; and the turtle and the crane and the swallow observe the time of their coming." So fixed are the dates of departing and returning with many tribes of the feathered race that, "in certain Eastern countries at the present day, almanacs are timed and bargains struck upon the data they supply." Now, who informs them that the day is come for them to take their leave? or announces to them that the time has arrived for their return? Without science, without a map, without a compass, without a waymark, who acquaints them with the direction they are to take? or measures out for them the length of the journey they have to perform? Who enables them to pursue undeviatingly their course over pathless oceans, and through the trackless voids of the atmosphere, alike in the day time and in the night season, and to arrive exactly at the same spot from year to year? To whom shall we ascribe this extraordinary power—to God, or to the little bird? It must be either to the

one, or to the other. It is obvious that the little bird does not possess either the reasoning powers, or the geographical acquaintance, or the meteorological knowledge, which would enable it either to plan or to carry out such astonishing enterprises. Indeed, could man thus, amid all storms and darkness, infallibly steer his voyages over the main, it would render superfluous the use of his compass and sextant, and enable him at once to dispense with his trigonometry and logarithms. Whatever name, then, we may give this mysterious power, and in whatever light we may regard these astonishing facts, correct and sound reasoning, as well as the Scripture, will lead us to the conviction and acknowledgment of the illustrious Newton, that all this is done through the immediate influence and guidance of Him, "in whom all live and move and have their being," and without whom "not a sparrow falleth to the ground."

In the feathered population of our globe we also behold, not proofs only, but *most interesting and delightful displays of the goodness of God.* The very introduction of the winged race into the new-made world was, in itself, a demonstration of the benevolence of the Divine Mind, as they constitute one of its most beautiful and lovely features. By the infinite diversity of their forms, sizes, and colors; by their wonderful instincts, and endearing associations; by their varied, and often brilliant plumage; by their swift and airy and playful flights; by their interesting and instructive

works and habits; and, by their diversified notes and warblings—the birds of the air add a thousand charms to the earth as a habitation for man. In ways without number do they minister both to his pleasure and profit —with their voices pouring the thrill of joy into the hope of his youth; with their flesh refreshing the strength of his manhood; and with their feathers soothing and warming the feebleness of his old age. Who has not been charmed by their melodious voices, resounding like a song of praise through the echoing forest? Who has not felt the pleasing inspiration of their presence, when contemplating with enraptured eye the lovely face of nature? In opening spring and glorious summer, how alive is every grove and thicket with their busy labors and cheery songs. And all this prevails over nearly every region of the earth's surface. If we leave our own temperate and charming zone, and advance to the higher latitudes of the globe, and pass within the polar circles, even there we shall witness similar scenes of happiness, for there are the great breeding grounds of the sea-birds, where they gather themselves together in countless myriads, and in the midst of abundant food and undisturbed quietude, taste the sweets of that mutual love, which is an emanation of the Divine Benevolence, the source of all happiness to earth and heaven. Truly, the earth is full of the riches of God's goodness; and is it not the design and desire of his Paternal Heart, by all these wonders of love, to call our attention, and to win our

affection to Himself, as the Great Fountain of all good?

Birds are *living parables.* In a manner equally beautiful and impressive are they pointed at by the Divine Teacher to inspire confidence in the care of our heavenly Father, and to allay within us all undue anxiety for the future. Looking down in the tender and abounding compassion of His soul upon benighted and erring humanity, laboring, restless, fevered, about the petty provisions of the present life; anxiously looking onward to the future; borrowing the distresses of the morrow to aggravate those of to-day; loading themselves with burdens of grief which do not belong to them, and which they are not required to bear—surveying with deep compassion, I say, this scene of toil, and sleepless anxiety, and wasting solicitude, in which mortals are embroiled, the Divine Friend of sinners, the Sympathizer with human woe, stretches forth His hand, and lifts up His voice, saying, "Take no thought for your life, what ye shall eat, and what ye shall drink; nor yet for your body, what ye shall put on. Is not the life more than meat, and the body than raiment? Behold the fowls of the air; for they sow not, neither do they reap, nor gather into barns; yet your heavenly Father feedeth them. Are ye not much better than they?" Than this, nothing can be more beautiful in description, nothing more conclusive in reasoning.

From a fowl of the air the Great Teacher, who spake as never man spoke, has read to us another lesson of

inimitable pathos and encouragement—it is from the conduct of the *domestic hen* toward her young brood. Behold her: what devoted affection, how vigilant for their safety, how diligent for their sustenance, how ready to interpose even her life for their protection! When an enemy appears, how anxiously does she call to assemble them, that she may cover them under her wings. When a shower or when the night approaches, with what kind complacence does she hide them amongst her feathers, and communicate to them the vital warmth of her own body. It is by this most beautiful and affecting image that our blessed Lord sets forth the anxious and inextinguishable compassion of His heart for sinners, even for the most guilty and ungrateful—"O Jerusalem, Jerusalem! thou that killest the prophets, and stonest them that are sent unto thee, how often would I have gathered thy children together, even as a hen gathereth her chickens under her wings, and ye would not."

To the foregoing, I cannot resist the temptation of adding another lesson of holy writ, drawn from the eagle's method of exciting her young to attempt their first flight. "As an eagle stirreth up her nest, fluttereth over her young, spreadeth abroad her wings, taketh them, beareth them on her wings: so Jehovah alone did lead him." Of a part of this instructive proceeding of the eagle, Sir Humphrey Davy was once an eye-witness. "I once saw a very interesting sight," says he, "above one of the crags of Ben Nevis. Two parent

eagles were teaching their offspring, two young birds, the manœuvres of flight. They began by rising from the top of the mountain, in the eye of the sun; it was about mid-day, and bright for that climate. They at first made small circles, and the young birds imitated them; they paused on their wings, waiting till they had made their first flight, and then took a second and larger gyration, always rising towards the sun, and enlarging their circle of flight, so as to make a gradually extending spiral. The young ones still slowly followed, apparently flying better as they mounted; and they continued this sublime kind of exercise, always rising, till they became mere points in the air, and the young ones were lost and afterwards their parents to our aching sight."—What a lesson is there in this narrative to every Christian parent. How powerfully does this conduct of the parent eagles appeal to such to teach their children betimes to look toward heaven and the Sun of Righteousness, and to elevate their desires and affections thither more and more on the wings of faith and love, themselves all the while going before them, and encouraging them by their example.

INSECTS.

And God created every winged thing after his kind.

On the fifth day were also produced the Insect population of the new-made world, for these, as well as birds, must be included in the term *winged thing.*

This department of animated nature presents to us a field of study all but illimitable, Insects being by far the most numerous and diversified of all the living orders that occupy the dry land. Not less than 100,000 different species are already known, and many more, doubtless, remain to be discovered. A distinguished naturalist has made the statement, that there are probably six species of insects to every species of plants; this estimate, therefore, would make the entire number of insect species on the face of the globe considerably over *half a million.* The insect tribes are of all conceivable forms, habits, and instincts. Volumes on volumes have been written concerning their organizations, powers, and doings, yet without in any way exhausting the fruitful subject.

In no province of the animal kingdom do we find Divine invention, design and adaptation, more diversified, or more conspicuously displayed, than in the insect race. Upon these fairy beings the Creator has bestowed by far the choicest gifts of animal powers; in them may be discovered all the mechanical instruments and apparatus required for the execution of those varied movements which we witness in the larger animals; and which, though almost peculiar to the different classes of those animals, are here frequently united in the same individual. Insects swim, dive, creep, walk, run, leap, or fly, with as much facility as fishes, reptiles, quadrupeds, or birds. But besides these, a great number have also movements peculiar to themselves, and of which we meet no example in other departments of the animal kingdom.

To fit them for all their peculiar movements and functions, the insect system is often found complicated and wonderful beyond all description. A distinguished French entomologist spent several years in examining the structure of a single insect, and then left the work unfinished. In the body of an insect about an inch long, another naturalist enumerated 306 plates, composing the structure of the outer envelope; 494 muscles for putting them in motion; 24 pairs of nerves; and 48 pairs of breathing organs. Nothing can exceed the perfection of the minutest parts of the insect organization. The finest thread in a spider's web, which can scarcely be seen, is said to be composed of no less than 4,000 strands. On a single wing of a butterfly have been found 100,000 scales; and on that of a silkworm moth 400,000; each of these minute scales being a marvel of beauty and completeness in itself. So thin are the wings of many insects that 50,000 placed over each other would only be a quarter of an inch thick; and yet, thin as they are, each is double. And when we consider, still further, the incomprehensibly delicate contrivances, and exquisite borings, and claspings, and jointings, which enter into the frame of an animated being a thousand times less than a mite, we cannot but be filled with adoring wonder in view of these living productions of the Creator's hand.

The bodies of insects are furnished with a great variety of external members or limbs. They have in general six legs, and the majority of them four wings;

to these, in many species, are added antennæ or a pair of feelers, an awl or ovipositor, a proboscis, and in a few also a sting. These all are found instruments of astonishing mechanical contrivances when examined through a powerful microscope. Equally remarkable are the mouths of insects; here we have the biting jaws of the beetle, the piercing proboscis of the bug, the long and elegant sucker of the butterfly, the licking tongue of the bee, the cutting lancets of the horse-fly, the sting tube of the gnat, and various other forms and modifications of this important organ.

Insects do not breathe through their mouth; consequently they have no voice, no power of song or speech. The various sounds they make, it is said, are generally produced by their wings. The air is brought into contact with their blood, that is to say, they breathe by means of little spiral orifices or holes, ranged in rows along their sides. The number of these breathing orifices differs in different species; some have ten pairs, some twenty, some forty, and some more still. A few species have their respiratory apparatus on their backs, while others still, breathe through their tails.

Insects are endowed with all the senses possessed by larger animals. The sense of *touch* is principally seated in the antennæ; it is by means of these organs they seem to measure bodies, try to lift them, and ascertain if they are too heavy, too hot, or too cold. Their sense of *smell* is delicate, and the slightest odor appears to strike them; distant honey attracts bees, and tainted

meat draws flies from afar. *Hearing* also, in many at least, is quite acute; grasshoppers, spiders, and other insects have been trained to respond to a given signal or call. Nor has the sense of *taste* been denied them, and of this they give decided evidence whenever a choice is set before them.

Insects are likewise endowed with *sight*. The eyes in numerous species are among the most curious and wonderful of all the works of the Creator on earth. Like birds, the eyes of some are formed to see in the dusk, and those of others in the broad and bright daylight. Certain aquatic species have several pairs, some looking up, and some down; so that while swimming on the water, the little creature can at once see the fish which threatens him from beneath, and the bird that is ready to pounce upon him from above. Others have three little eyes, arranged in the form of a triangle, on their heads, making three powerful microscopes; these are found in insects inhabiting dimly-lighted places. On the head of a fly are two large protuberances, one on each side; these are its organs of vision. The whole surface of these prominences is covered with a multitude of small hemispheres, arranged closely and with the utmost regularity. These little hemispheres have each of them a minute transparent convex lens in the middle, each of which has a distinct branch of the optic nerve ministering to it; so that the different lenses may be considered as so many distinct eyes. Of these eyes, the beetle has

on each side 3,180; the common house-fly 4,000; the drone-fly 7,000; and the dragon-fly 13,500—each of which, in all these, is capable of receiving and forming a distinct image of any object that may stand or lie before it. Leuwenhoek, having adjusted the eye of a fly for the purpose, could see distinctly in each of these diminutive lenses, though not larger than the point of the finest needle, the whole steeple of a church, which was 299 feet high, and 750 feet distant; and then turning it toward a neighboring house, saw through many of these little hemispheres, not only the front of the house, but also the doors and windows, and could discern distinctly whether the windows were open or shut! Such a piece of mechanism transcends all comprehension.

Some tribes of insects appear to be endowed with a faculty answering, to a certain extent, the purposes of *speech*. They utter no sounds, indeed—none at least audible to the human ear; but their language is that of signs and motions. On the abstraction of the queen-bee, those sensible of the loss have been observed, in traversing the hive, to cross their antennæ over others they may encounter, and strike them gently, on which, as if distinctly apprised thereby of the disaster, the bees which thus receive the intelligence hurry away in the greatest uneasiness and alarm. A similar mode of communication has been observed among ants. Here the signal denoting danger is made by the ant striking its head against the corselet of every ant which it

chances to meet. Each ant on receiving this intimation immediately sets about repeating the same signal to the next ant which may come in its way; and the alarm is thus disseminated with astonishing rapidity throughout the whole society. Sentinels are, at all times, stationed on the outside of the nest for the purpose of apprising the inhabitants of any danger that may be at hand. On the attack of an enemy, these guardians enter quickly into the nest, and spread the intelligence on every side; the whole swarm is soon in motion, and while the greater number of ants rush forward with desperate fury to repel the attack, others, which are entrusted with the eggs and larvæ, hasten to remove their charge to places of greater security.

Many of the insect tribes also give unmistakable evidence of their being actuated by the passions of *love and hatred, joy and fear, sympathy and anger*. These are plainly exhibited in some by significant actions, and in others by a variety of sounds, which, however inexpressive to the careless observer, are doubtless full of meaning to themselves. Accordingly, we sometimes see them fearless with anger, sometimes fleeing in terror, sometimes intoxicated with pleasure; now we witness them courting their favorites, and now assaulting their enemies; here we behold them fluttering in joyous affection over their young, there exulting in triumph over their foes. These are all scenes often observed in and about both the hive and the ant-hill, And demonstrations of insect passions equally striking

may be daily witnessed around every spider's retreat. Let a fly, through carelessness or by accident, become entangled in his web, and what a spectacle ensues! How manifest the terror and despair of the unfortunate fly at the approach of its inexorable enemy—how frantic its efforts to escape from his clutches—how touching its last and dying struggles! On the other hand, what exultation in the spider; what ferocity in plunging his fangs into his helpless victim; what malignant cruelty in every movement! Who can contemplate such a scene, and not be sensibly affected even by the passions of insects; or fail to regard them as a vivid mimicry of the mightier paroxysms of man?

Insects excel in *strength*. Their muscles are endowed, in proportion to their size, with power far superior to that of larger animals. Ants will carry loads which are forty or fifty times heavier than their own weight. The beetle can move a weight one hundred and twelve times greater than its own. The house-fly's wing has a power of six hundred strokes in a second, which can impel it through a space of thirty-five feet; whilst the speed of a race horse is but ninety feet a second. A dragon-fly can dart through the air at the rate of sixty miles an hour; and the dexterity of this insect is more surprising than its swiftness, for it is able to do what no bird can—it is able to stop instantaneously in the midst of its most rapid course, and change the direction of its flight, going sideways or backward, without altering the position of its body.

Thousands of bees hang one to another, without detaching or tearing asunder the feet of the upper ones: how many human beings could thus hang one upon another? Were an elephant as strong in proportion to its weight as a stag-beetle, it would be able to tear up rocks and level mountains. The strength of insects appears equally astonishing in the distances many of them are capable of leaping. The cuckoo-spit frog-hopper can leap more than two hundred and fifty times its own length; and could a horse spring the distance, in proportion to his weight, that a flea can in proportion to its weight, he could at once clear the loftiest peak of the Andes, and at a single bound cross a continent. The feats of agility and strength exhibited by insects are, indeed, very surprising.

Nothing, perhaps, connected with insects has so much arrested the attention and excited the wonder of common observers, as their *mode of reproduction.* Almost all the insect species are oviparous, and their progeny pass through four distinct states of existence. They are first contained in eggs, which are deposited by their parents in suitable situations, and with a degree of instinctive care, which fills us with wonder. From the eggs they are hatched into active and rapacious grubs, maggots, or caterpillars, according to the tribe to which they belong. Having attained their maturity in this latter state, they retire to some safe retreat, and envelop themselves in silk, or wrap themselves in a covering of leaves, or entomb themselves in

the earth, according to the habits of the species; and now for a time, with many of them, all appearance of vitality is suspended, and they seem like miniature mummies. Having remained till the proper season in this chrysalis state, as it is termed, they burst and throw off the vestments of the tomb, and with beauty of form, and with powers before unknown, they come forth perfect insects, and enter upon the duties and enjoyments of their fourth and last stage of existence. Nothing can be more wonderful than these transformations. Here we behold a hairy caterpillar metamorphosed into a gorgeous butterfly—and observe how great the change. We have four beautiful wings where there were none before; a tubular proboscis in the place of a mouth, with jaws and teeth; six long legs instead of fourteen feet! Herein we see a most astonishing process, indeed, and one full of interest and hopeful intimation to man, as we shall presently have occasion to state more at large.

The blessing of *fecundity* was bestowed in all its power and fulness upon the insect races, as upon the fish of the sea and the fowls of the air. Indeed, all language is inadequate to convey an idea of "the power to bring forth" with which these little creatures were endowed in the day of their creation. They have multiplied till they have literally covered the whole earth. They abound wherever we go; they enter our houses and dwell with us; they cross our paths, frequent our gardens, swarm our fields, buzz

through the woods, and swim upon the waters. Their hum falls upon our ear by day and by night. The fecundity of insects, of course, is more marked in some species than in others. The spider will produce from 100 to 200 of its kind at a single brood. A house-fly will lay 177 eggs. Some silk-worms lay from 1,000 to 2,000 eggs; the wasp deposits 3,000; the ant from 4,000 to 5,000. The queen-bee, according to Kirby and Spence, lays in one season a number ranging from 40,000 to 50,000. But above all, the white ant produces 86,400 eggs each day, which, continuing for a month, gives the astonishing number of 2,592,000—a number far exceeding that produced by any known animal above animalcula. These may appear like the statements in which a fictionist might indulge, but they are the sober truths discovered by the most painstaking and cautious observers. And it seems to be necessary that such conditions should prevail. These insects, and all the lower tribes of the animal kingdom, furnish food for the more elevated races. Thousands are born in an hour, and millions upon millions perish in a day.

In many low and luxuriant regions, gnats, mosquitoes, and a variety of other insects, thicken the whole atmosphere; while in other districts, that are higher and drier, the ground is alive with ants, crickets, grasshoppers, and innumerable hosts of other tribes. Swarms of locusts have sometimes shut out the light of the sun, and laid waste whole kingdoms.

ADVANCING CLOUD OF LOCUSTS.

At the call of Moses, "locusts came up over the land of Egypt, and rested in all her coasts; very grievous were they, for they covered the face of the whole earth, so that the land was darkened; and they did eat every herb of the land, and all the fruit of the trees; and there remained not any green thing in the trees, or in the herbs of the field, throughout all the land of Egypt." The prophet Joel gives a most animated description of a similar visitation, that was brought on the land of Judea, at a later period, for the iniquity of the people.

Modern travellers have frequently, and in different parts of the globe, witnessed scenes that abundantly corroborate these accounts of the sacred volume. Mr. Barrow records that, in the Southern district of Africa, which he visited, the surface of nearly 2,000 square miles might be said to be covered by locusts. The water of a wide river was scarcely visible in consequence of the innumerable drowned locusts which floated on its surface. By and by these countless hosts were driven into the sea by a violent wind; and their bodies, being thrown back again on the shore, formed a bank about three feet high, and of many miles in length. Another eye-witness of a locust army says, "The column extended five miles, and the insects flew so close together that they darkened the light of the sun as an eclipse; whilst the sound of their wings was as the distant roar of the ocean in a storm." Thus we see that the blessing of reproducing power, bestowed

on the fifth day, still remains unwasted and undiminished after the lapse of so many ages.

Of all animated beings, insects exhibit the most numerous, and the most surprising displays of *instinctive sagacity*. This opens to the student of nature a wide field of wonders; but our limits will permit us to notice a few examples only.

The ingenuity, cunning, and stratagems of the Spider, have been subjects of observation and interest from remote antiquity. Solomon mentions this little creature among the small things that are wise upon the earth, and as manifesting its wisdom by "taking hold with her hands." And truly, what the spider does with her hands, and her spinning organs, is very wonderful. The *garden spider* is a most skilful aeronaut, and practised his art with consummate success, long ages before its discovery by man; it constructs its balloon with silk of its own manufacture, and wafts along, or ascends on high, with ease and rapidity, in its airy chariot. The *water spider*, from time immemorial, has been familiar with all the triumphs of the diving-bell; it fabricates for itself a covering in which it can safely dive, remain at the bottom of pools and streams, there build for itself a dry and comfortable habitation; from this it daily ascends in quest of prey, and having secured it, carries it down to his subaquatic mansion, to be devoured at its pleasure. Another species, called the *builder*, is eminently gifted with architectural talents; but its

structures are always under ground. There it excavates rooms, bores galleries, forms vaults, constructs bridges, and carves out entrances. Its habitation, when completed and garnished, is always remarkable for the extreme neatness which reigns there. Whatever the humidity of the soil in which it is built, water never penetrates it; the walls are nicely covered with tapestry of silk, having usually the lustre of satin, and are almost always of dazzling whiteness. But the most remarkably ingenious of all the contrivances about its habitation is the door at its entrance, which lacks nothing but a lock, for it is nicely fitted to a frame, and actually works upon a hinge. This door, upon close examination, is found to be a complicated fabric, being formed of no less than thirty layers of earth and web, emboxed in each other. On the outside, it is coated with soil similar to the surrounding earth, so that the existence of an entrance would hardly be suspected. And what is very striking, the door is so hinged that, whether the spider enters or goes out, it is sure to shut of itself. The advantage of this adjustment is great and obvious; for, whether it darts out upon its prey, or retreats before an enemy, no time need be lost in shutting the door. In these operations of spiders, we discover *designs* so wise, *contrivances* so happy, and *adaptations* so successful, as plainly prove that the blessed Creator has taught each the lessons of its life-duties.

Equally remarkable are the instinctive doings of

Ants. These diminutive creatures live in numerous communities, and under a republican form of government, every individual enjoying a large measure of personal liberty, having its own special office, and performing its duties with assiduous diligence. They constitute a united, peaceful, and happy society. Of ants there are several distinct species, and we glance first at what are familiarly called *hill-ants.* In building their habitation, the first business with these is to excavate a cavity in the earth; this accomplished, one troop immediately sets about collecting suitable materials, and working them into a roof over the entrance; while another detachment mixes up the earth with particles of leaves and grass, thus rendering it more suitable for building. Here and there open spaces are left, which, after the skeleton of the building is completed, are converted into galleries, which lead to different apartments, all of which meet in a large chamber in the centre of the nest, which is the favorite residence of the ants. The roof is of a conical form, and is neatly thatched with straw, so as to shed all rain. They work principally in the day-time; toward night all the avenues, like the gates of a walled city, are carefully closed one after another, with, what must seem to them, huge logs of timber. Before the last is thus secured, they retire inside to repose for the night; three or four, however, remain outside to perform the duty of sentinels. Early every morning the avenues are again opened, and the ants resume their several

HABITATIONS OF TERMITES, OR WHITE ANTS.

avocations. In rainy weather they remain closed the entire day; and at any time that rain commences, they are forthwith barricaded.

The sagacity of these tiny people is truly marvellous. A close and experienced observer once, watching with interest their various movements, discovered one trying to drag along a little bit of wood much larger than its own body. "After getting along for a time pretty well," says he, "the poor little fellow came to a steep ascent, and found, to his utter dismay, that it was too heavy, and that he could proceed with it no further. Some of his friends, however, happening to pass by, came to his assistance, and by their united efforts the piece of wood was soon placed on the summit. They then left our hero to work by himself, fearing, perhaps, that further assistance might lead to indolence. So all alone he again manfully resumed his task; but, alas! a fresh difficulty soon presented itself. His load was thicker at one end than at the other, and while dragging it along, he incautiously drew it in between two pieces of wood, where it remained firmly fixed. He pulled, and pulled, but in vain; there it staid. He paused—at length, as if a happy thought had struck him, he darted to the other end, and dragged it out, took it a short way round, and soon arrived at his destination."* Here we see instinctive sagacity carried to the very borders of reason itself.

Let us look at another species, the *Legionary Ant.*

* Imperial Magazine, No. 127.

These live in great part by plunder, and enslaving ants of another class. The history of one of their marauding expeditions, as given by Huber, is full of interest, and will serve to convey an idea of their general character. Whilst walking in the environs of Geneva, towards the close of a fine summer's day, "I observed," says he, "close at my feet, traversing the road, a column of legionary ants. They moved with considerable rapidity, and occupied a space of from eight to ten inches in length, by three or four in breadth. They soon approached a nest inhabited by a colony of the negro ants, the dome of which rose above the grass. Some of the negroes were guarding the entrance; but on the discovery of an approaching army, darted forth on the advancing legion. The alarm spread instantly into the interior, whence their companions rushed forth in multitudes to defend their homes. The legionaries, the bulk of whose army lay only at the distance of two paces, quickened their march, and when they arrived at the hill, the whole battalion fell furiously upon the negroes, who, after an obstinate though brief contest, fled to their subterranean galleries. The legionaries now ascended the dome, collected in crowds on the summit, and taking possession of the principal avenues, left some of their companions to excavate other openings in the exterior walls. They soon effected this, and through the breach the remainder of the army made their entrance; but in about three or four minutes afterwards issued

forth again, each carrying a pupa or grub, with which booty they retraced their route. On arriving at their own encampment, thus laden with the trophies of victory, their domestic servants, of the same negro race, came forth to welcome the returning warriors, caressing them, and presenting them with food; whilst the legionaries, in their turn, handed over to them their baby captives to be carried into the interior of the nest, there to be nursed and cared for until they arrived at maturity. From which it appears that the only object of these predatory expeditions, is to obtain possession of the young, while in the insensible state of pupa, or ant babyhood. The plunderers never make prisoners of the old negroes. The consequence is, that all their captives become domesticated without difficulty, and become obedient and useful servants to their owners—nursing their young, transporting them from one part of the colony to another, gathering provisions, building new galleries, and acting as faithful guards and sentinels to their captors, who rest tranquilly at the bottom of their subterranean city, till the hour fixed for another expedition arrives."

To witness such performances carried on among insects amazes, and well nigh confounds us! And the reader, while he wonders at the striking indications of intelligence which they exhibit, may be startled, and, perhaps, shocked, to discover thus a perfect system of invasion, capture and slavery, even among ants. But a moment's reflection may serve to relieve

his mind. The captives are as well off here as they would have been in their own colony; they are conscious of no degradation, and fare in all respects as well as their masters.

Let us take one more example of instinctive skill and sagacity, that of the *Bee*. No nation of the earth, it has been said, has had its history written so often as this curious little insect. Bees live, not singly or in pairs, but in large communities, of which the Queen-bee is mother as well as sovereign, who is always treated with the greatest respect and attention by all her subjects. Bees are altogether a most wonderful people —their regulations and loyalty, their science in planning their habitations, their skill in building them, their division of labor, their co-operation in difficulties, their economy of provisions and materials, their untiring industry, their providence in accumulating for the future, their inviolable observance of law and order, and their consequent, undisturbed harmony and peace as a society—are all subjects of most interesting and instructive study. The interior of the hive presents us, indeed, with a concourse of marvels; it is a city on a small scale, with its dwellings and streets, built on the most perfect plan that could possibly have been contrived for the use of the inhabitants. Some of these buildings are storehouses for food; in some the citizens live; and a few, more capacious than the rest, are for the royal family. And the material of which this city is built is one which man, with all his skill

and resources, knows not how to produce; and the city itself the most experienced architect could not have planned with more wisdom.

The combs are composed of two ranges of cells opening on the opposite sides; these are built about half an inch apart, thus leaving a commodious street between them. There are also openings left through different parts of the combs, forming cross lanes, to save time in going round. The shape of each cell in the comb is that of a hexagon, or six-sided tube. This figure possesses many important advantages over every other that could have been employed—no space or room is lost, the cells fitting close together; the greatest saving of wax is secured, each partition forming the sides of two contiguous cells, and one floor answering for the two ranges of cells. By adopting this figure and arrangement, each cell is also greatly strengthened by all the adjoining cells. The bottom of every cell is not a flat piece, but terminates in a three-sided point, and this rests against the point where three partitions meet on the other side, and is thus supported by the walls of the cell opposite, which gives it all the strength possible, while this is exactly the best plan to save the wax and the room.

This problem was once given to a celebrated mathematician, namely, *To show how a certain quantity of wax could be made to form cells of the same size and shape, so as to give the greatest strength and the most room, and at the same time to use the smallest amount of the material.* After considering the question in

every aspect possible, and trying it by the strictest rules of geometry, the answer proved that the bees had acted as if acquainted with all these principles, and had, in the most simple and perfect manner, secured every advantage of arrangement in the building of their cells. How marvellous that a diminutive insect, so trifling in the sight of man, should be able to do all this! And what unspeakably heightens the marvel is, that every young swarm, without instruction and without experience, in its first attempt, accomplishes this feat of scientific arrangement with exquisite perfection and unerring skill!

In the form, material, arrangement and connection of the cells in the honey-comb, we see what is unquestionably the result of *intelligence*, and of no ordinary intelligence, as they embrace profound mathematical principles, which man has only attained by difficult and protracted study. And now the question is, whose intelligence? To ascribe it to the insect would be to endow the infant-bee with scientific ability, rivalling that of a Bernoulli or a Brougham. But if this we cannot do, it remains for us only to ascribe it to the Omnipresent God, who worketh all in all. Blind, indeed, must he be, or what is worse, wilfully perverse, who can view all this, and fail or refuse to acknowledge the guiding power of the Supreme and Universal MIND in it. All nature, and all life, down to the minutest of the insect tribes, reveal a *present* DEITY. Their mysterious works and ways are only intelligible in such a presence. And in

the marvels of the Bee-hive we witness special and vivid evidences of the presence and agency of the Unseen Creator.

REFLECTIONS.

Insects, like every other class of living creatures, have their place to occupy, and their office to fulfil in the Divine plan, and form an essential link in the great chain of animated nature. Small and insignificant as they appear, viewed singly, yet taken collectively, they make up armies far more potent and formidable than either Alexander, or Cæsar, or Bonaparte ever mustered; and these being everywhere dispersed, and daily and hourly at work in their several departments, they constitute an agency of great power, and no doubt of great good, in the economy of the world. We may not be able to determine how, or what, each particular species contributes to the benefit of the great whole; but we may be sure that their great variety of organs, and their wonderful instinctive capacities, have been bestowed upon them for ends worthy of the wisdom that produced them. The works of the Lord are perfect, and nothing has been made in vain.

> "———— Each moss,
> Each shell, each crawling insect holds a rank
> Important in the plan of Him who framed
> This scale of beings; holds a rank, which, lost,
> Would break the chain, and leave a gap,
> That nature's self would rue."

Insects are an ornament to the earth's scenery, and, no doubt, were designed by the munificent Creator to be objects of pleasurable observation and study to man. "Next to the birds," says Kirby, "nothing adds more to the life of the scenes before us, than the vast variety of insects that are flying, running and jumping about in all directions, all engaged in their several pursuits—the bees humming over the flowers, the butterflies opening and shutting their painted wings to the sun, the swarming gnats in ceaseless maze rising and falling alternately in the sunbeams, the beetle wheeling his drowsy flight, others coursing over the ground, and the grasshopper chirping in every bank—all adding to the general harmony, and combining to make the general picture one of life and love; and speaking, each in a different sort and manner, the praises of its Creator, and calling upon man to join in the general hymn."

The insect creation, at which we have now glanced, teaches us that God is to be seen in the least as well as in the greatest of His works. He is in all and through all. The guidance of His finger is to be traced as distinctly in the circles of the spider's web as in the orbits of the planets; and the operation of His hand is as plainly seen in the lustre of an insect's wing, as in the resplendent disk of the sun, which sheds light and life on surrounding globes. When we contemplate the insect world—the vast number and variety of its species; the wonderful powers and faculties with which they are endowed; the delicacy

and complication of their parts; their strength of limbs and swiftness of flight; their exquisite organs of sight and touch and smell and hearing; their quickness to discern their enemies, and their ability to communicate alarm; their manifestation of love and hatred, anger and joy; their ingenious homes and instinctive skill; their reproductive energies and marvellous transformations; their cunning, artifice, and stratagems; their tact, industry, and perseverance, together with a multitude of other traits and operations —when we contemplate all these, I say, we find ourselves surrounded with a profusion of evidences, baffling every attempt to comprehend them all, that every living thing is the work of the Divine Hand, and that no animated being is too minute for His notice, or too humble for the visitation of His care. Nor should *we*, assuredly, regard them beneath our notice. Study and reflection upon these, the handiworks of the Creator, were intended to feed the flame of religion in the soul, and to maintain within it an abiding sense of the Divine Presence. Every insect is a lesson full of divinity, and its examination should be to us a devotional exercise. And to a mind accustomed to consecrate all its perceptions of beauty and design to the inward worship of God,

> "How sweet to muse on His skill display'd,
> Infinite skill! in all that He has made;
> To trace in nature's most minute design
> The signature and stamp of power Divine;

Contrivance exquisite expressed with ease,
Where unassisted sight no beauty sees;
The shapely limb and lubricated joint,
Within the small dimensions of a point;
Muscle and nerve miraculously spun,
His mighty work, who speaks and it is done;
Th' INVISIBLE in things scarce seen reveal'd,
To whom an atom is an ample field."

—*Cowper.*

The insect population of our world exhibits the most pleasing evidences that the Creator designed, and has provided means of enjoyment and happiness for all His creatures, even the lowest and the least. While every tribe of these little creatures seem content with their lot, and charmed with their own pursuits, some species live in a style of felicity and splendor that presents the most striking displays of the goodness of God. In illustration of this point, I quote the pleasing and lively description given by Sir John Hill of his discoveries within a fragrant *carnation:* "Distending the lower part of the flower, and adapting my microscope to take in the whole at one view, its base under its influence extended into a vast plain; the slender stems of the leaves became trunks of so many stately cedars; the threads in the middle seemed columns of massy structure, supporting at the top several ornaments; and the narrow spaces between were enlarged into walks, parterres, and terraces. On the polished bottoms of these, brighter than Parian marble, walked in pairs, alone, or in larger companies, the winged inhabitants; these from little dusky flies, for such

only the naked eye would have shown them, were raised to glorious, glittering animals, stained with living purple, and with a glossy gold, that would have made all the labors of the loom contemptible in the comparison. I could, at leisure, as they walked together, admire their elegant limbs, their velvet shoulders, and their silken wings; their backs vying with the empyrean in its blue; and their eyes, each formed of a thousand others, outglittering the little planes on a brilliant; above description, and too great almost for admiration! I could observe them here singling out their favorite females; courting them with the music of their buzzing wings with little songs, formed for their little organs; leading them from walk to walk among the perfumed shades, and pointing out to their taste the drop of liquid nectar, just bursting from some vein within the living trunk—here were the perfumed groves, the more than mystic shades, of the poet's fancy, realized. Here the happy lovers spent their days in joyful dalliance, or, in the triumph of their little hearts, skipped after one another from stem to stem, among the painted trees, or winged their short flight to the close shadow of some broader leaf, to revel in the heights of all felicity." In scenes such as this, we behold not only the workmanship of God, but also the riches of His beneficence toward the least of the creatures which His hands have made.

In the history of insects, we meet with the most beautiful illustration that all nature affords of the

great and distinguishing doctrine of Christianity—*the Resurrection of the Dead.* And to see this, let us follow one of these little animals through the marvellous changes of its existence. Our starting point is a diminutive and almost invisible egg; from this comes a worm, scarce an inch long at maturity, doomed to draw out its little length to obtain locomotion from day to day. Prone on the earth, it is passed and repassed unnoticed. Its appointed days in this condition drawing to a close, it languishes; refuses to eat; ceases to move; becomes wrapped in a silken shroud; this soon changes into a dusky crust; and in this, as in its coffin, it remains apparently dead. The time of its sepulture, usually six or seven months, having passed away, it begins to acquire new life and vigor; presently it bursts open its confining cell, and comes forth; no longer, however, an offensive crawling worm, but changed and fashioned into a beauteous butterfly, furnished with limbs and wings, and decked in down of purple and gold. It now takes rank with a new and superior race of beings; it mounts the air, ranges from flower to flower, rises in exhilarating flights towards the glorious orb of day, rejoicing in its new and splendid existence. Who but must see in all this a striking parallel, and an instructive type of the blessed change that awaits the righteous? Like the caterpillar worm, they now are doomed for a brief period to tread the soil of earth, and then to be laid to sleep within the tomb. But they remain there only

for an appointed time; a day cometh, when, like the worm, they shall come forth from the wreck and ruin of the grave, in forms lovely as that of the Son of God, and shall mount up with wings, shall join the angelic holy throng, and dwell forever with the Lord. Let the works of God, then, confirm to us His word; let the wonderful display of His power and wisdom, as thus seen in the transformation of insects, serve to strengthen our faith, and to animate our hope of a blessed immortality.

This metamorphosis of insects supplies *an admonition to the wicked*, as well as an encouragement to the righteous. Microscopic examinations have shown that the body of the caterpillar contains the future butterfly in embryo. At this period, it frequently happens that a certain insect, called *ichneumon fly*, will pierce and deposit her eggs in the living body of the caterpillar, which are hatched there into grubs or larvæ, and feed upon the inward parts of their victim. A most remarkable circumstance connected with this process is, that a caterpillar which has been thus attacked goes on feeding, and apparently thriving quite as well, during the whole of its larva life, as those that have escaped. For, by a wonderful provision of instinct, the ichneumon grubs within do not injure any of the organs of the caterpillar, but feed only on the *future butterfly* enclosed within it. And, consequently, it is hardly possible to distinguish a caterpillar which has these enemies within it from those that are untouched.

But when the period arrives for the close of the caterpillar life, the difference appears. While those unhurt emerge into butterflies, of the unfortunate caterpillar that has been preyed upon, nothing remains but a blackened form—the hidden butterfly has been secretly consumed. Striking emblem of a multitude of our race! A secret enemy, Satan, has quietly taken his abode within them likewise, there gradually but steadily enfeebling and destroying the indwelling soul; yet without producing outwardly any marked change, or interfering materially with their well-being during the present stage of their existence, and whose fatal work may not be detected till the time arrives for *the last great change!*

I.

The Sixth Day.

Beasts, and Cattle, and Creeping Things are created.

THE SIXTH DAY.

GENESIS 1 : 24–28. And God said, Let the earth bring forth the living creature after his kind, cattle and creeping thing, and beast of the earth after his kind: and it was so. And God made the beast of the earth after his kind, and cattle after their kind, and every thing that creepeth upon the earth after his kind: and God saw that it was good.

BEASTS.

THE work of this day is but a continuation of that of the preceding, both having been employed to furnish the earth with its living tenants. On the fifth day the sea was replenished with fish, and the air with fowl and flying things; and to-day beasts and cattle, and creeping things shall be brought forth for the dry land; and, finally, man the head and crown of all. The history of this day, so far as the production of the brute creation is concerned, needs but little explanation.

Let the earth bring forth. It is not to be supposed from this particular mode of expression, that creative power was delegated to the *earth*, or that prolific virtue was imparted to the soil, to produce its own living tenants; for, in speaking of the actual execution of the work in the next verse, it is explicitly stated that it was God that created them, one and all. Omnipotence alone is adequate to produce living beings. *Spontane-*

ous generation of life is a thing unknown. The distinguished Agassiz, after having most emphatically rejected this notion, speaking merely as a naturalist, affirms that, "it is necessary that we recur to a *cause* more exalted, and recognize influences more powerful, exercising over all nature an action more direct, if we would not move eternally in a vicious circle." Every existing living organism has come from a parent, and every original parent came from the hand of God, for He alone can produce life.

God made each living creature, it is said, *after his kind.* By this phrase we are to understand, not only that God contrived and created the different species of animals in all their variety of forms, instincts, and habits; but also, that He so made them, as to produce each its own kind, and its own kind only, through all its successive generations. It is in virtue of this law, a law established throughout the animal kingdom, that the several races of animals have been kept distinct from the foundation of the world to the present day. By this ordination of the Creator, the transmutation of species, so much talked of by a certain school of infidels, was rendered impossible. "Each and every species," says Lyell, "was endowed, at the time of its creation, with the attributes and organs by which it is now distinguished." *But for this,* the world long since would have been filled with *confusion.*

Cattle—under this term are included the various species of tame and domestic animals, such as sheep,

oxen, etc.; particularly herbivorous creatures. *Beasts*—this word is usually applied in the Scriptures to wild animals, such as lions and bears; especially such as are carnivorous. *Creeping thing*—this designates the reptile family, such as serpents, frogs, etc. The animal creations of this day are all included under these three terms. In each of these classes, like those provinces of creation already surveyed, we shall meet with innumerable displays of the wisdom and goodness of the great Creator.

CATTLE, or DOMESTIC ANIMALS.

And God made the cattle after their kind.

Although man was the last work of creation, yet in the plan and purpose of God he was the first and the head, for the world with its furniture was contrived and arranged with manifest reference to his wants and convenience. Several species of the animals produced on this day seem to have been expressly designed, and specifically endowed with their respective qualities, for his particular and immediate benefit—some to supply him with food, some to furnish him with clothing, and some to bow their patient necks to aid him in his toils and travels. Indeed, with this class of animals the comfort and prosperity of the human family are intimately connected; peaceful tenants of the earth, they also add by their presence fresh and cheering beauty to meadow and mountain, and impart life and spirit to every scene on which they appear.

Of the animals designed for the immediate service of man, *Sheep* offer themselves first to our notice. Sheep are associated with the earliest history of the world, and the first family of our race; Abel, we read, was a keeper of sheep. These animals are found in great variety, and are very valuable to man, as they yield him both food and clothing. Hence they have constituted an important item of individual and national wealth in all ages. At the present day they are raised and fed by millions in every quarter of the globe. And they can be reared in situations and on soils where other domestic animals cannot be supported; at the same time they are susceptible of indefinite improvement both as to form of body and quality of wool. No domestic creatures, perhaps, are of greater value, certainly none that could supply their place. Were this gift of the Creator withdrawn, or the race suffered to diminish and become extinct, it would be to man an incalculable loss.

Cattle, or the Bovine family, also, were specifically formed and constituted to minister to the good of man; and to his dominion they readily yield. Accordingly, like sheep, we find that they have been domesticated from the earliest times. The patient ox has always bowed his neck to the yoke of man, and aided him in the toil through which he has been doomed to raise and eat his daily bread. And the gentle cow has contributed more abundantly towards his sustenance and gratification than any other living animal. In

many respects, we are more dependent on this race of creatures than on any other. Cattle are of various kinds or species; and these differ widely in size and character, from the ungainly Brahmin cattle, scarcely exceeding the size of a large mastiff, to those of the Eluth Tartars, which often attain the height of seven or eight feet. Cattle are also so constituted as to be equally capable of enduring the intensity of heat and the rigor of cold; they can live and thrive on the frozen fields of Iceland, and in the burning deserts of Libya; and they readily accommodate themselves in disposition and habits, to a remarkable degree, to the peculiarities of whatever region they may be placed in. They are thus qualified to accompany man in all his widespread migrations over the face of the globe.

The Creator foresaw that man would need another and a different assistant—one to carry his burdens, to work his fields, and to bear him swiftly in his travels—and in His kindness provided such an assistant in the *Horse*. In this animal are combined all the qualifications that could be desired in such a servant—excelling in strength, speed, endurance, docility and affection. With a mouth tempered to bear the bit without suffering, a foot of firmness to bear additional weight under rapid motion, and of a disposition that he can be tamed in a few hours, and brought to submit, and even to rejoice in his rider. Add to all this that, of all quadrupeds the horse reaches the highest point of symmetry and perfection; possessing a most graceful

form, an intelligent eye, expressive nostrils, "a neck clothed with thunder," and swiftness that often outstrips the wind. This striking combination of so many rare and noble qualities, seem to prove that the horse was expressly made for the service of man; and in how many ways this valuable gift of the Creator contributes to his necessities, and to his pleasure, are too well known to need specification.

The horse, strong and docile though he be, is not well adapted for many parts of the earth; hence in those regions man finds another and a most suitable help in the *Camel*. This animal, indeed, is only known as the servant and follower of man; and it appears to have been distinctly formed by the Author of nature to contribute to his comfort in the great parched and sandy wildernesses of Asia and Africa, where the horse could neither travel nor subsist. The camel's feet seem expressly made for travelling over the loose deep sands of those regions, being divided above, but connected beneath, thus presenting broad and pliable surfaces that, like the hunter's snow-shoes, bear him up where the compact hoof of the horse would sink so far as to impede his progress, and soon exhaust his strength. To the camel has also been given great strength, and such a patient and docile disposition that, with little or no instruction, he will kneel down to receive his load and his rider, and has a provision, namely, pads, on his knees and breast for that purpose. Add to all this, streams and wells being

scarce, and in general found only at distant intervals in these hot deserts, the camel is also provided with an additional stomach, or *reservoir* as it may be regarded, in which he can carry a surplus stock of water. The hump on his back also is a surplus store of fat, from which the system can draw nourishment when deprived for a time of his proper food. Thus constituted, this remarkable animal will post forward at the rate of six or eight miles an hour, through those vast deserts, where are neither birds, nor beasts, nor vegetation, nor water, and where nothing is to be seen but hills of sand and heaps of stone, for a whole week without drink, without pasture, or any sustenance whatever. In Arabia, and other tropical countries, the camel is venerated as a special gift of Heaven, without whose help the inhabitants could neither subsist, traffic, nor travel. Its milk makes part of their nourishment, they feed upon its flesh, they clothe themselves with its hair; and, if they fear an invading enemy, their camels serve them for rapid flight, and to convey them in a single day to the distance of a hundred miles. We cannot but admire, in this remarkable instance, the beneficent intentions of Providence, in the structure, disposition and habits of an animal so exceedingly adapted to regions of heat, sterility and drought. If we look over the whole animal kingdom, not a beast can be found that would supply its place.

Another beast constituted to be eminently helpful to man, in different regions still, is the *Elephant*. This

is the largest animal that treads our globe at the present day; his average height is from eight to ten feet; and his weight varies from 5,000 to 9,000 pounds. His strength is prodigious; his legs differ from those of all other animals, being strong and massive pillars, formed with admirable mechanical skill for sustaining immense weights. He is capable of bearing on his mighty back a battlemented tower, garrisoned with armed men; and will thus advance with fearless step to meet the shock of battle, ploughing his way through whole serried battalions. His head is large, and contains two long and heavy tusks; his neck is short, so that it will not admit of the mouth reaching the ground to feed. But to counterbalance this defect, and also to overcome the difficulty arising from the tusks, the elephant is provided with an instrument of admirable structure in his proboscis or trunk. This he can draw up, or shoot out, or twist in any direction at his pleasure. Its essential office is to supply the animal with food, and with it he can crop the grass at his feet, or browse the twigs and leaves over his head; through it also he can draw up water, and afterwards discharge it into the throat, or over the body. This proboscis terminates in a flexible point like a finger, and which appears to be endowed with the sense of touch, so that with it he can readily hold any small object, or pick up a piece of money, or even a pin, from the floor. He is, moreover, the most sagacious of all animals; and when tamed, he becomes the most gentle, obedient,

and affectionate of domestic animals, capable of being trained to any service necessary in those climates of which he is a native. He is endowed with the faculty of memory in an astonishing degree, and displays so much moderation, gratitude, and fidelity in his attendance on man, that the ancients, misled by his demeanor, considered him to possess the moral virtues.

A multitude of well authenticated accounts of the elephant's sagacity and affectionate disposition are on record. "The Philosophical Transactions" relate an instance where this animal had conceived a special attachment to an infant. "He was never happy except when the infant was near him. The nurse, therefore, frequently took the child in its cradle, and placed the latter between his feet. He at last refused his food when the infant was absent. When it was asleep, he watched it with great solicitude, and drove off the flies with his trunk as they approached. If it awoke and cried, he would rock the cradle till it again fell asleep."

So great, often, becomes the affection of the elephant for his conductor or driver that he will defend him with his life. It is related that one of the soldiers of Pyrrhus, king of Epirus, when fighting in the territory of Argos, fell wounded from his elephant, when the noble animal immediately rushed furiously among the combatants till he found his master, whom he then gently raised from the ground with his trunk, and, placing him on his tusks, carried him back to the town. And when king Porus, in a battle with Alexander the

Great, met with a similar misfortune, his faithful elephant is said to have kept the enemy at bay till he had replaced the monarch on his back with his trunk; but the poor animal lost his life in this heroic defence of his master.

In the high and cold latitudes of the north, owing both to the severity of the climate and to the character of the vegetation, neither the horse, nor the camel, nor the elephant could subsist; yet the great Father of all has not left those branches of the human family that have pushed, or been pushed, into those inhospitable regions, unprovided with suitable help—to them He has given the *Reindeer*, an animal whose appetite and powers of digestion enable it to flourish even on the coarse and scanty lichens of Lapland and Spitzbergen, and which supplies to them the place of the horse, the cow, and the sheep. It is to them invaluable and indispensable.

> "The reindeer form their riches: these their tents,
> Their robes, their beds, and all their homely wealth,
> Supply—their wholesome fare and cheerful cups:
> Obsequious to their call, the docile tribe
> Yield to the sled their necks, and whirl them swift
> O'er hill and dale."

It was foreseen also that man in a thousand circumstances would need another helper different from all those now described—an active, sagacious, faithful friend, to guard his home, to attend him in the chase, and to lighten the labors of tending his flocks and his herds—and this friendly assistant is supplied in the

trusty *Dog*. Every thing pertaining to this animal indicates that it was made for the service of man—his intelligence, his docility, his faithfulness, and his strong attachment to his master, preferring his society to that of his own species; and, unlike most other animals, remembering only his caresses, is ready in a few moments to kiss the hand that smote him. The dog is a most valuable servant to man. How important the service he renders to the Esquimaux, to the Alpine traveller, to the shepherd, to the hunter, and to the herdsman!

The dog kind is a numerous family; more than twenty varieties are domesticated. Of all these the St. Bernard and the Scotch shepherd dog are the most remarkable for their intelligence and fidelity. The former, by their keen scent and wonderful sagacity, have discovered, and saved from death, many unfortunate travellers bewildered by snow-storms, or overwhelmed by avalanches, on the great Alps. Though the perishing man lie ten or twenty feet below the snow, such is the extreme delicacy of their sense of smell that they will discover the spot; and then they will immediately begin to scratch away the snow, at the same time setting up a continued hoarse and solemn bark, to attract notice and assistance in the work of rescue. One of these noble creatures is said to have in this manner saved the lives of twenty-two persons, and perished at last himself in an attempt to save another.

The shepherd dog displays equal sagacity and affec-

tion. When trained, he perfectly understands the commands of his master, and with admirable intelligence united to the most unwearied industry and perseverance, will execute them. This faithful little creature has often been taught to bring along a flock of sheep after his master wherever he chose to go; and even to drive them unaided and alone from one place to another. One such dog is of more help to the mountain shepherd than twenty men could possibly be.

The affection of the dog for his master is very strong and remarkable, instances of which are recorded that cannot be read without emotion. Some have been known to take their station on the grave of their human friend, refusing food with the most steady resolution, till they pined to death. A dog of the Marquis Langally, during his absence, became dejected and cheerless; and, on his sudden return, expired for joy. The lap-dog of Mary, Queen of Scots, followed her to the scaffold, and would not leave the body till forced away, and, two days afterward, died of a broken heart.

In addition to the several evidences already noticed, that the foregoing animals were expressly created for the service of man, we may state this further proof, that to each of them has been given the form and disposition and degree of sagacity that most happily fit it for its intended place and purpose. To illustrate this—of what value would the dog be, with all his other commendable qualities, if only his body had been like

that of the hog, or if his disposition had been that of the sheep? So of the horse; of what service had this noble animal been to man, notwithstanding the strength of his limbs, the symmetry of his form, and all his high sagacity, if only his temper had been that of the tiger; or, with all his present intelligence, gentleness and docility, if only his body had been like that of a leopard? Again: had sheep, though of finest fleece, been endowed with the ferocity of the hyena, who would want to surround himself with a flock of them; or, if covered with bristles instead of wool, where had been their peculiar value? But, instead of anything of this kind, we see given to every domestic animal those qualifications that eminently fit it to render to man its specific service. And what still adds greatly to the proof of creative design in this matter is, that domestic animals have been so constituted as to be *susceptible of improvement* under the judicious care and management of man. Accordingly, the sheep has been made to yield a finer fleece, the cow to give a more abundant supply of milk, the horse to become more fleet and powerful, and the dog more sagacious, under his protection and skill. And this last named quality seems to have been intended by the Creator in reward for kind care and judicious management of these useful animals.

REFLECTIONS.

In domestic animals we recognize a very marked token of the Paternal kindness of the Creator. Their

value and importance to man cannot well be estimated. How much do they add to his strength in toil, to his ease and speed in travelling, and to his sustenance and gratification in food. Had he not been provided with the sheep and the cow, how differently had both his table and his wardrobe been furnished. And had he not received for his helpers the ox, the dog, and the horse, he had never attained his present position in the world; and were he to be deprived of them, he could not maintain that position for half a generation. How manifest, then, the Divine goodness in the creation and gift of our domestic attendants.

Constituted for willing obedience, and bestowed in great kindness by the Creator, as these animals have been, yet how grossly are they often abused. While so ready to submit and to labor for our good, it is painful to think of the cruel treatment they receive at the hands of many, being unfeelingly overworked—brutally beaten—half fed—urged by spur and whip to panting exhaustion—or set with savage delight to fight and tear one another. What vile abuse! What shocking cruelty! No language can sufficiently reprobate such inhumanity. Would that those guilty of it would stop and reflect that these submissive animals are not senseless machines, not so many automata formed of wood and brass, but creatures endowed with sense and feeling like their own. Their sufferings are real like their own. They give forth every indication of this. They utter distinct cries of pain. They manifest terror, and

often tremble, when menaced with a blow. They exhibit the same distortions of agony after the infliction of it. The bruise, the gash, the fracture, affect them similarly to ourselves. They sicken, suffer, grow feeble, and die, as we do. And their agonies are without the alleviation of fellow-sympathy while they writhe under them, or that of hope when they shall have been passed. They have to suffer in silence and alone. They cannot complain, they cannot tell the depth or intensity of their sufferings. And this very shroud of silence, how it aggravates tenfold the heartless cruelty that inflicts those sufferings on a dumb animal. As not a sparrow, so assuredly not one of these, falleth without our Father. His tender mercy is over all His works. Their groans enter into His ear, nor will He forget them, when He cometh to render unto all according as their works have been.

As we are to receive these domestic animals with gratitude, and to treat them with kindness, so also *we are to regard them with reflection*, for they are appointed to symbolize to us many important truths. If we view them simply as tools or useful helps, or even rest satisfied with admiring their pleasing natural excellences, we shall overlook and miss a crowning benefit to be derived from them. As God's beneficent consideration for man's wants is nowhere more conspicuously seen than in this class of animals, so through no other class of emblems are the instructions of his gospel and the purposes of his grace more clearly set forth.

Even the Dog proffers to us a serious and profitable lesson. "Man," said the poet Burns, "is the god of the dog. He knows no other, he can understand no other. And see how he worships him. With what reverence he crouches at his feet, with what love he fawns upon him, with what dependence he looks up to him, and with what cheerful alacrity he obeys him! His whole soul is wrapped up in his god; all the powers and faculties of his nature are devoted to his service, and these powers and faculties are ennobled by the intercourse. Divines tell us that it ought to be just so with the Christian; but does not the dog often put the Christian to shame?"

The Ox, also, is to us a living parable. As he slowly wends his way from the field of toil, at noon or evening, toward home, how affecting the remonstrance his moving figure is made to utter—"The ox knoweth his owner, and the ass his master's crib; but Israel doth not know, my people do not consider." And when he bows his submissive neck to receive the yoke, and go forth to his labor again, how gracious the invitation symbolized by the willing act—"Take my yoke upon you, and learn of me; for I am meek and lowly in heart, and ye shall find rest unto your souls. For my yoke is easy, and my burden is light."

The Sheep, likewise, is a sacred emblem. Were this animal to repeat all the various truths committed by the Spirit to its symbolism, it would preach to us a new lesson with every change of situation in which we

beheld it—following after the shepherd—enclosed in the fold—scattered on the mountain—lying down in green pastures—straying among wolves—borne on the shepherd's shoulder—bound before the shearer—separating from the goats—in these various circumstances, sheep read to us the most solemn and important truths of the gospel of the Son of God.

And the Lamb—this is the central symbol of the Christian system. This innocent and gentle creature is pre-eminently the type of HIM who was holy, harmless, and undefiled, the Lamb of God that was slain to take away the sin of the world, in whose blood the redeemed of heaven have washed their robes and made them white.

The Horse also is a chosen figure of inspiration. In the book of Revelation—that wonderful portion of the sacred volume—the KING of kings, and LORD of lords, is represented as riding on a *white horse;* and the armies of heaven as following Him upon *white horses*, clothed in fine linen, white and clean, to witness His victory over all the enemies of truth and righteousness, and to participate in the final triumphs of His grace. Such is the deeply interesting event, such the glorious consummation, of which the horse stands forever a symbol and a remembrancer before his rider.

How wise the arrangement that has thus embodied Divine Truth in living forms, that ever move before our view. How kind and gracious in God our Father thus to constitute "sheep and oxen" to be unto us as

priests and prophets, holding forth the word of life, and, though they see not the vision themselves, symbolizing the glorious things of Christ and of heaven, to inspire us with the comfort of the most blessed hope.

BEASTS, or WILD ANIMALS.

And God made the beast of the earth after his kind.

The term *beast* in the history of this day, as has already been stated, is employed to designate wild animals, in contradistinction from the tame, included under the word *cattle*. Although these are not designed so immediately, or so eminently for the service of man as domestic animals, yet many, if not most of them, contribute in one way or another to his welfare—some as game for his sustenance, some by their hides and fur for his clothing, and all as subjects of interesting and profitable study. Following the usual order and classification, we notice first, those termed

QUADRUMANA, or four-handed beasts. This order includes the orang-outang, chimpanzee, ape, baboon and monkey. These animals are naturally inhabitants of forests; it is there they are at home, and find the food most suitable to their nature. Their inner toe, on both fore and hind feet, assumes the form and office of a thumb, opposed to the other toes and fingers; so that they can use all four for grasping the branches, and springing from one to another, and are thus enabled to walk through the trees, or run up and down their

THE TIGER.

spreading tops, with as much ease and celerity as we can our staircases.

The *Orang-outang*, an inhabitant of Borneo and Sumatra, is the most perfect of this order, and the one of all animals that most resembles man. In stature this animal, it is said, sometimes reaches nearly six feet; it is broad-chested, muscular, and very powerful. Its visage is very like the human face, only the eyes are more deeply sunk, and the whole body is covered lightly with hair. Both their instinctive and imitative capacities are quite remarkable. Buffon, the naturalist, speaks of a tamed one that would sit at table, pour out his tea, put sugar and milk into it, wait for it to cool, and then drink it, as men did. All he did in this way, however, was simply imitative.

The *Chimpanzee*, found in Congo and Guinea, also, it is stated, sometimes approaches the human stature. These live principally on the ground, and, as their name imports, spend much of their time in caves or under rocks. When molested, they will unitedly defend themselves with such fury and courage that even the elephant and the lion are obliged to retreat before them. The *Monkey* is found of various sizes, some are not larger than a small cat, some are vicious and savage, some are ill-formed and disgusting. What are called Ring-tailed monkeys live and move in great troops or armies. Many of the monkey family possess a high degree of instinctive sagacity.

While quadrumana present the nearest approxima-

tion to the human form and stature, yet upon examination great and essential differences are found in their organization from that of man. "Any anatomist," says Prof. Jeffries Wyman, "who will take the trouble to compare the skeleton even of the negro with that of the orang, cannot fail to be struck at sight with the wide gap which separates them." The volume of brain in man compared with that in the orang-outang is as *five* to *one;* and the human brain contains parts which do not exist in the brain of any other animal species. Sœmmering has enumerated as many as fifteen important anatomical differences between the brain of man and that of the orang. These animals, by great care and protracted training, can be taught to do some things mechanically; but when we try our hand upon their mental powers for improvement, we find at once that we have got no foundation on which to build. The entire field of what we call knowledge lies absolutely beyond their reach. We may subject them to the best discipline of which they are capable during their whole lives, and yet we cannot get them possessed of a single idea, either literary or scientific. And as for conscience, they have none; and by no process can we awaken or create moral sensibilities in their nature; indeed, the idea of exhibiting moral truth to them is simply ridiculous. Conscience, or the moral sense, is found in man alone, and constitutes his highest distinction.

CHEIROPTERANS, or hand-winged animals. This order

embraces bats, vampires, flying-cats, etc. The *Bat* is a singular animal, and seems to form a connecting link between birds and quadrupeds. One of its most extraordinary faculties is that of a knowledge of the presence, and apparently of the approach of objects, by some other sense or medium than that of vision. Blind bats fly among the trees as well as those that have eyes. Spallanzani found that those whose eyes he had put out avoided most expertly threads of fine silk, which he had so stretched as just to leave room for them to pass between. Whilst the bat of our own country is quite a diminutive creature, that of Madagascar is a monster, whose outstretched wings measure full four feet; and these assemble sometimes in such numbers as darken the air, and they devour every thing in their way.

PREDACEANS, or preying animals. This order includes the lion, bear, tiger, leopard, panther, hyena, jackal, wolf, fox, otter, marten, sable, ermine, etc.

The *Lion* has long been styled "the king of beasts," and truly he is a royal animal. His form and mien are striking, his look confident and bold, his gait proud, and his roar terrible. It is sufficient but to see him in order to be assured of his superior strength. His large head surrounded with a dreadful mane, all those muscles that appear under the skin swelling with the slightest exertion, and the great breadth of his paws, with the thickness of his limbs, plainly evince that no other animal in the forest is capable of opposing him.

His face is broad, and is surrounded with long hair, which gives it a very majestic air. His huge eyebrows; his round and fiery eyeballs, which, upon the least irritation, seem to glow with peculiar lustre, together with the formidable appearance of his teeth, exhibit a picture of terrific animal grandeur which it is impossible to describe. The length of a large lion is between eight and nine feet, and his height about four and a half feet. His strength is prodigious; with one stroke of his paw he can break the back or crush the skull of a horse. He meets with intrepidity his most formidable enemies; and will boldly face man himself, and brave the force of all his arms. Wounds serve rather to provoke his rage than to repress his ardor. Nor is he daunted by the opposition of numbers; a single lion of the desert often attacks a whole caravan, and after an obstinate combat, when he finds himself overpowered, instead of flying, he continues to fight, retreating and facing the enemy till he dies. These powerful and terrible beasts are the terror of man in many regions; but happily, says Buffon, the species is not numerous, and it seems to be diminishing daily. This royal animal, though fierce and formidable to all others, is gentle and ever faithful to his chosen female companion. She lies in the same thicket or den, and partakes of the same prey with himself. Towards her and her cubs he exhibits parental and conjugal affection, no less strong or striking than those manifested by the sweet singers of the grove. In this animal,

indeed, all the passions, even those of the most gentle kind, appear almost in excess, yet wonderfully modified and adapted to his appointed place and circumstances.

The *Tiger* is somewhat smaller than the lion, but is decidedly more ferocious. The strength of the Royal Tiger is such, that he has been known to carry away a man in his mouth as a dog would a bone, and even to drag a buffalo whole to his den. Though fierce and cruel in the extreme, yet of all quadrupeds it has the most beautiful skin, both for gloss and colors. The frightful teeth and savage nature of this and of other wild beasts, at first view, shock all our best sensibilities, as they seem to reflect on the benevolence of the Creator. But there is wisdom, and there is mercy even in this savageness and these powerful weapons of destruction planted in their jaws,—it is to shorten the dying pangs of their victims, which otherwise might have been killed by protracted torture.

The *Leopard*, in form, is like the tiger, only much smaller; and like that animal is fierce and cruel, attacking almost every thing he meets. Nothing, however, can be more beautiful than the active and elegant manner in which leopards will sometimes sport among the branches of the trees.

The *Bear* is another of the formidable beasts belonging to this class. Of this animal there are several varieties, inhabiting different parts of the earth, from the Indian islands to the Arctic regions. The Kamtschatka bear is to the inhabitants almost what the rein-

deer is to the Laplanders;—of the skin they make clothes, bed-coverings, gloves, harness, and ice-shoes; the fat supplies them with oil for their winter lamps; their flesh is to them for venison; and the skin of the intestines for their window-glass. The polar bear, as its name implies, inhabits the highest and coldest latitudes. This is a very formidable creature, and sometimes grows to the enormous length of ten or eleven feet. In the summer these live on ice islands, and are capable of swimming several leagues from one to another. They lodge in dens formed in large masses of ice. But, however desolate the habitation assigned them, or savage the aspect they present, even these animals exhibit traits of fidelity and affection which we cannot but admire. When the Carcasse Frigate was locked up in the northern ice, a she-bear, and her two cubs, nearly as large as herself, came toward it one day. The crew threw to them great lumps of sea-horse blubber. The old bear fetched these away singly, and divided them between the young ones, reserving but a small piece for herself. The sailors shot the cubs as she was conveying the last portion, and wounded her. She could just crawl with it to them, tore it in pieces, and laid it before them. When she saw that they did not eat, she laid her paws first on one, then on the other, and tried to raise them up, moaning pitifully all the time. She then moved from them, looked back, and moaned as if for them to follow her. Finding they did not, she returned, smelt them,

and licked their wounds; again she left them, and again returned; and with signs of inexpressible fondness went round them, pawing and moaning. At last she raised her head toward the ship, and uttered a growl of despair, when a volley of musket balls killed her. Such is the strong and tender affection implanted by the Divine Hand, even in a lone and savage beast, and from which its scarce less savage destroyers might well have learned a profitable lesson.

The *Marten*, *Sable*, *Ermine*, etc., are remarkable, and are chiefly valued, for their fine and much esteemed fur; that of the ermine being used by royalty to adorn its richest robes.

Rodentes, or nibblers and gnawers. This order embraces the hare, rabbit, beaver, porcupine, rat, mouse, marmot, guinea-pig, squirrel, etc. Most of these are so familiar as to need no description. The *Rabbit* is an animal found in nearly every part of the world, and is specially remarkable for its extraordinary fecundity; a single pair, it has been calculated, would, if they had no enemies, in four years, produce a progeny of *more than a million.*

The *Hare* among us is generally noticed only for its extreme timidity and watchfulness; but it has a sister, or a little creature nearly related to it, called *Pika*, which is gifted by the Creator with a remarkable instinct. Of this interesting little animal, Kirby, in his Bridgewater Treatise, gives the following particulars. They inhabit the most northern districts of the Asiatic

continent, and always select for their abode the rudest and most retired spots, and often the centre of the most gloomy and humid forest, where the herbage is fresh and abundant. Here they employ themselves during summer in *making hay* for a winter store. This work is usually begun about the middle of August. With ready and unfailing skill they select their favorite herbs and grasses, and bringing them near their habitation, they spread them out to dry like hay. In September, they form stacks of the fodder they have thus collected, under the rocks, or in other places, sheltered from the rain and snow. When many of them have labored together, their stacks are sometimes as high as a man, and seven or eight feet in diameter. All the grasses and herbs are cut when most vigorous, and dried so slowly as to form a green and succulent fodder. A subterranean gallery leads from the burrow below the mass of hay, so that neither frost nor snow can intercept their communication with it through the winter. Who but must acknowledge the guidance of an unseen Hand in all this? Of these stacks collected and laid up with so much patient toil, the poor little creatures are often cruelly robbed by the wretched inhabitants, to feed their horses and cattle. Instead of imitating the foresight and industry of the provident Pika, they heartlessly rob it of its means of support, and so devote the animals that set them so good an example to famine and to death.

The *Hamster Rat*, the *Field Mouse*, and other ani-

mals of this class, make a similar provision for winter, conveying in the season when food is to be found a suitable and sufficient quantity to their subterranean dwellings—a procedure in which man may discern a serious admonition to make due preparation for the evening of life and the winter of the grave.

But of this order, and perhaps of all quadrupeds, the *Beaver* is the most remarkable for its instinctive doings. In length, the beaver is about three feet, and the tail, which is flat and of an oval shape, and covered with scales, about a foot more. It has five toes on all its feet, which in the hind pair are connected by a membrane, and thus aid in swimming; whilst those on the fore legs are separate, and serve as hands to convey food to its mouth, to carry stones, to mix mortar, and build its structures. But the incisor teeth of these animals are their principal instruments; with these they can cut down trees eight or ten inches in diameter; and when they undertake this operation, they gnaw it all round, cutting it sagaciously on one side higher than the other, and thus cause it to fall in the direction they wish. The beavers live in communities of some two or three hundred, and build their houses near together, each of which is occupied by a family of from two to a dozen members. They are creatures of strong and tender affection, and the utmost order and harmony prevail in the family, and in the community at large.

The location selected by the beavers for their city is generally a pond encompassed by banks of soil, and of

a certain elevation. But if they cannot find such a site, they choose a flat piece of ground, with a stream running through it; across this stream, in order to create a pond, they will construct a dam, which is at once a marvel of skill and industry. It is composed of stakes five or six feet high, firmly and closely implanted in the ground; these are intertwined with twigs and roots, and all the interstices compactly filled up with stones and mud; and thus with prodigious labor they build a substantial and impervious dyke, eight or ten feet thick at the bottom, and sometimes a hundred feet long. Where the current is weak, the dam is almost straight; but where the flow is more rapid and powerful, it is made to curve with the convex side opposed to the stream, thus presenting to it the strength and firmness of an arch. Their houses stand along the edge of the water, and are built of the same materials, and with equal skill. In their erection they begin to excavate some three or four feet under water, at the base of the bank, enlarging gradually upwards, so as to form a declivity till they reach the surface; and of the earth which comes out of this cavity they form a hillock, mixing with it small pieces of wood, together with stones. They give this hillock the form of a dome, from four to seven feet high, and from eight to ten wide. As they proceed in heightening, they hollow it out below, so as to form the lodge which is to receive the family. At the anterior of this dwelling, they form a gentle declivity terminating in the water, so that they

enter and go out under water. This chamber is plastered with surprising neatness on the inside. Sometimes the interior is divided by partitions into several rooms. At a little distance is the magazine for provisions, of which they generally have an abundant stock on hand. In short, the contrivances about the beavers' dwellings are calculated to fill us with admiration; and, at first appearance, we might well imagine them the productions of intelligent beings.

EDENTES, or animals whose distinctive character is to have no fore teeth. This order contains the armadillo, ant-eaters, ornithorhynchus, sloth, pangolin, etc. In these we meet with striking exhibitions of the endless diversity of the Creator's works.

The *Ornithorhynchus* is a remarkable creature; it is a quadruped, yet oviparous; it has the bill of a duck, and is almost web-footed; and the male, like the serpent, is armed with a sting, or poisoned spur, situated in its hind legs. Blumenbach termed it a *paradox*.

The *Ant-eater*, also, is a peculiar animal; it sometimes measures six or seven feet in length and two feet in height. It is clothed in a suit of scale-armor. Its snout is one-fourth the length of its whole body; its tongue is cylindrical, and often thirty inches long; and this curious member, smeared with adhesive mucus, it thrusts among the busy ants, and draws them into its mouth by thousands; and thence they are conveyed whole into what Prof. Owen has called the triturating gizzard of a fowl.

RUMINANTS, or animals that chew the cud. This order embraces, beside the sheep, oxen and camel, already described, the deer, elk, antelope, llama, chamois, giraffe, buffalo, musk, ibex, etc.

These animals are all herbivorous, and the *ruminating process* by which they are distinguished is truly wonderful. Their stomach is generally divided into four distinct cavities, or chambers; the first of which serves as a receptacle for the grass or herbage, coarsely ground by the first mastication; into the second this mass enters gradually, and is there rolled up into small balls; by a voluntary action these balls are brought up again, one after another, into the mouth, and undergo a second and more thorough process of mastication; after this it descends into the third stomach, and after undergoing the action of that, passes into the fourth, where it is subjected to the digestive process. The liquids drunk by the full-grown animal pass at once into the second stomach to moisten the balls; while the milk taken by the calf, which does not require to be either macerated or ruminated, is conveyed directly into the fourth stomach for digestion. Here, then, we behold a series of organs, mutually related and dependent, and performing a series of progressive operations, which exhibit design and adaptation as clearly as the mill which grinds our corn, or the machine that weaves our garments.

Of *Deer* there is quite a variety, and they are the most elegant and airy, both in form and motion, of the

whole class, and seem intended as one of the principal living organs of the globe. The *Gazelle* and the *Antelope* are among the fleetest of quadrupeds, and exhibit the highest perfection of structure belonging to this type. The *Chamois* performs feats of agility that baffle all efforts at its capture, and overwhelm with astonishment its pursuers; it has often been seen to leap down a perpendicular precipice of twenty or thirty feet high, without sustaining the slightest injury.

The *Giraffe* is also a stately and beautiful animal. It is very tall, its head sometimes standing full eighteen feet from the ground; stretching out its long neck and long tongue, it can browse far up the trees. These magnificent animals adorn the vast plains of the interior of Africa.

The *Bison* or *Buffalo* is another notable ruminant, found both in the Old and in the New World. This animal, with its shaggy mane, and fierce and fiery eye, though belonging to the ox family, presents no slight analogy to the lion, the king of beasts. Over the great central plains of North America, the buffalo roam and migrate in vast, and sometimes almost innumerable herds; and the Indian reckons them among his most valued game; every part and parcel of those he takes serving him either as food, or clothing, or for the manufacture of his weapons and implements.

PACHYDERMS, or thick-skinned animals. This order embraces the Elephant, already described, together with the *Rhinoceros*, the *Tapir*, and the *Hippopotamus*.

These are the giants of the earth. The *Rhinoceros* is scarce inferior in size to the elephant, but, unlike that animal, is wholly untractable. One species of this creature has two horns, one behind the other, on the snout; but those generally known have only one. This protects all the face, and is a most formidable weapon; the tiger dreads it even more than the tusks of the elephant. Sometimes this horn is four feet in length, and six inches in diameter at the base. The skin of the rhinoceros is so thick and impenetrable that the fiercest and strongest animals can do it but little damage.

The *Hippopotamus* likewise is a vast and unwieldy looking animal, but of inoffensive habits. Its enormous head and mouth, armed with tusks, give it a striking appearance. Its home is in the still and sedgy waters of Africa. By means of a beautiful contrivance this beast can remain for some time below water, and feed on the subaqueous herbage. Throughout the night, these unwieldy monsters may be heard snorting and blowing during their aquatic gambols, and not unfrequently may be discovered sallying from their reed-grown coverts to graze by the serene light of the moon. Their hide is an inch and a half thick, and being scarcely flexible, may be dragged from the ribs in strips like the planks from a ship's side. This is supposed by some to be the animal called Behemoth in the Scripture. The *Tapir* acts the same part nearly in the New World that the hippopotamus does in

the Old. These animals, of giant bulk and irresistible strength, can make their way through thickest forests, and thus often open paths for man to traverse woods and jungles, that would otherwise mock his efforts to penetrate them.

MARSUPIANS, or animals that are provided with abdominal pouches, into which the young, at a very early stage of development, are received, and nourished with milk secreted from glands contained within these pouches. To this order belong the kangaroo, opossum, wombat, koula, etc.

The *Kangaroo* is an animal of considerable size, measuring sometimes eight or nine feet from the nose to the tip of the tail, and weighing some one hundred and fifty pounds. Its fore quarters are quite slender, whilst its hind quarters are remarkably robust and incrassated; it sits erect, resting upon them like a hare; it has a powerful tail, which it uses as a fifth leg. Whilst the fore legs of a full grown kangaroo measure only some eighteen inches, the hind legs measure full forty inches. With this peculiar form, this animal will spring forward a distance of twenty or twenty-five feet at a single leap; and though it cannot run fast, its springs are so rapid in succession, that, at times, it will distance the fleetest greyhound.

The *Opossum* brings forth its young, and rears them in an abdominal sack, like the kangaroo. Opossums are peculiar to America, and are remarkable for having a greater number of teeth than any other animal,

amounting in all to fifty. Its tail is uncommonly long, and which it uses, not only for climbing and swinging from branch to branch, but also for a support to its young, which sit on its back, and twist their tails round their mother's, in order to prevent them from falling off. When disturbed or alarmed, it gives out an offensive odor.

REFLECTIONS.

It is stated in the Holy Scriptures concerning the various branches of the human family, that "God before appointed the bounds of their respective habitations;" this is equally true of the different tribes of animals. Wise *design* and kind *adaptation* stand forth conspicuously in the arrangement which has assigned to them their several localities. The hairless elephant, rhinoceros and tapir are obviously made for the heat and luxuriance of the Torrid Zone; and it is there they are found. The camel and the dromedary have been fashioned and constituted with specific adaptations for the parched and sandy deserts of the tropics; and here, accordingly, they have been located. Advancing to the more temperate regions, we still find all creatures, both domestic and wild, admirably fitted to occupy the zone given to them for their inheritance. And as we proceed northward, we discover given to the various animals hardihood of constitution, together with warmth of covering, increasing with the increasing rigor of the climate, till we pass within the Arctic

circle, and reach the polar bears. Voyagers in those latitudes tell us that these animals disport in regions of ice, and revel in an intensity of cold, which, to man, with every contrivance of art for protection, is almost past endurance, and produces in him diseases which shortly terminate his existence,—that they sit for hours like statues upon icebergs, where, if we were to take up our position for one half hour, we should become statues indeed, and be frozen into the lasting rigidity of death,—that they slide in frolic down slopes of snow, which, if we were to touch with our bare hand, would instantly, like fire, destroy its vitality. Who that contemplates these shaggy creatures of the pole, so constituted as to find a congenial home amid eternal ice and snow, and to take their frolicsome pastime amid the bleak and dismal horrors of an arctic night, but must confess that every creature, by Divine appointment and adaptation, is suited for its place, and that every place is fitted for its given occupants?

While this general adaptation of animals for their intended localities plainly indicates the kind providence of God, the destructive character and predaceous habits of many of them, at first blush, are far from corresponding to our ideas of the Divine benevolence. When we see the prowling wolf spring upon the playful lamb, and tear it in pieces; or the taloned vulture descend and bear away the mother hen from among her helpless brood; or the rapacious shark dive into a shoal of smaller fish and devour them by the hundred out of

the midst of their happy gambols—such scenes shock all our sensibilities as horrid cruelties, and, for a moment, we stagger in our attempts to reconcile them with the benevolence we have been taught to ascribe to the Creator. A little reflection, however, serves to present this subject in a milder and more favorable light.

According to the existing order of creation, all animals must die in one way or another; for, were all to live on, and multiply as they do now, it would require but a short period before their progeny would exceed the capacity of nature to support them. Immortality for animals, therefore, upon the earth is out of the question. Consequently every living thing must die, either by acute disease, or by slow decay, or by violence. "The simple and natural life of brutes is not often visited by acute distempers; nor could it be deemed an improvement of their lot if it were. Let it be considered, therefore, in what a condition of suffering and misery a brute animal is placed, which is left to perish by decay. In human sickness or infirmity, there is the assistance of man's rational fellow-creatures, if not to alleviate his pains, at least to minister to his necessities, and to supply the place of his own activity. A brute, in his wild and natural state, does every thing for himself. When his strength, therefore, or his speed, or his limbs, or his senses fail him, he is delivered over either to absolute famine, or to the protracted wretchedness of a life slowly wasted by scarcity of food.

Is it, then, to see the world filled with drooping, superannuated, half-starved, helpless and unhelped animals, that we would alter the present system of pursuit and prey?"*

To the foregoing remarks we may add that, death to an animal by violence from another is attended by a far less amount of suffering, than we are apt to suppose; for, when it comes, it generally comes too suddenly to admit of much pain. Incapable of reflection, the lamb browses untroubled by a thought of death until it is actually upon him. And the hare, as Paley again observes, notwithstanding the number of its dangers and enemies, is as playful an animal as any other. And when actually under the paw, or within the jaws of the destroyer, its actual suffering may not be as great as we have been led to imagine. The account which Dr. Livingston gives of his sensations when the lion seized him by his arm, "and shook him as a terrier-dog does a rat," would lead us to the conclusion that appearances here may be deceptive. "The shock," he says, "produced a stupor similar to that which seems to be felt by a mouse after the first shake of the cat. It caused a sort of dreaminess, in which there was no sense of pain, nor feeling of terror, though I was quite conscious of all that was happening. It was like what patients partly under the influence of chloroform describe, who see the operation, but feel not

* Paley's Natural Theology.

the knife." He infers that the same complacency is common to animals when between the jaws of their enemies, and is an express and merciful provision of the Creator. In fact, though disease is often painful, the act of dying is not. Multitudes have testified to its ease with their last breath; both drowning and hanging are said to be attended even with pleasurable feelings; and death by freezing with "sleepy comfort." And as man is more highly *nerved*, more acutely sensitive, than the lower animals, their sufferings must be less; and, altogether, it may reasonably be inferred that the pangs which death inflicts upon them are not very great. Since, therefore, death in one form or another is unavoidable to all animals, if any one class of them is at greater disadvantage than another, it would appear to be that class which perishes slowly and from natural decay.

REPTILES.

And God made every creeping thing that creepeth upon the earth after his kind.

Under this designation are included the various orders of reptiles that inhabit the earth. While many of these from the earliest ages have been held in abhorrence, and studiously avoided as unclean and hateful creatures, yet careful and intelligent observation has discovered in them many extraordinary qualities and interesting habits, adding much to the

accumulated evidences we have of the inexhaustible resources of the Divine Intelligence.

Several species of reptiles are amphibious; these have cold blood, are oviparous, and have lungs of a very simple structure. Some of them are furnished with formidable teeth, and some have none. Some are fierce and predaceous, others are perfectly harmless. The bodies of all are cold to the touch, and this, together with the sliminess of some and the squalid appearance of most of them, has made them in general objects of aversion.

SAURIANS, or Lizards. This family comprises no less than four hundred and sixty species; and among them the most notable is the *Crocodile*. This voracious and dreaded animal lives along the banks and in the waters of the great rivers of the Torrid Zone. In shape it resembles the common lizard, and walks, or rather crawls, on four short legs; its body tapering into a lengthy tail. It is encased in strong and close scales, as in a coat of mail, impervious even to a musket ball. It sometimes grows to the enormous size of twenty feet in length, and five feet in circumference, yet its eggs scarce exceed in size those of a swan, of which it lays from seventy to eighty; but, by a merciful arrangement of Providence, most of these are destroyed. Its mouth is immense, and armed with a frightful array of sharp teeth. Its bellowing noise is equal to that of an ox. A great part of its time is spent in the water, and floats on its surface like a dead tree; or else secretes itself in

the tall reeds by the river side; and when a steer, a tiger, or even the lion himself, comes to drink, it will sometimes spring upon him, and succeed in dragging him under water, and making him its prey. Its strength is prodigious; with one stroke of its tail, it has been known to dash a strong boat into splinters; yet these animals are capable of being tamed. Bruce mentions in his Travels, that in Abyssinia, children may be seen riding on their backs; and it is a well known historical fact that, the priests in the temple of Memphis, in the celebration of their heathen mysteries, were in the habit of introducing tame crocodiles to the deluded multitude as objects of worship. They were fed from the hands of their conductors, and decorated with jewels and wreaths of flowers.

The *Gavial* of India differs somewhat from the crocodile of Egypt, in the form and furniture of its mouth, while in length of body it exceeds it by many feet, and is a most formidable animal.

Nearly allied to the foregoing is the *Alligator*, or American crocodile. It is much smaller, however, than either of them. This species formerly abounded in the south-western region of the United States, in nearly every stream and lake. "On the Red River, before it was navigated by steam vessels, they were so extremely abundant that, to see hundreds at a time along the shores, or on the immense rafts of floating or stranded timber, was quite a common occurrence, the smaller on the backs of the larger, groaning and utter-

ing their bellowing noise, like thousands of irritated bulls about to meet in fight; but all so careless of man, that he might paddle by them unnoticed."

To this class belong a multitude of smaller creatures, of the lizard type; some of which are predatory, but by far the greater part are inoffensive, though their repulsive looks and cold surface make them shunned. Yet some species there are which are distinguished for the beauty of their colors, the splendor of their scales, eclipsing even the most brilliant plumage.

CHELONIANS, or Tortoises. Of this family there are more than one hundred and twenty different species; some inhabiting salt water, some fresh water, and some living entirely on the dry land. The body of the *Tortoise* is protected by two large horny plates, one above and the other below, and joined at the edges. This covering is of amazing strength. One of the large species has been known to bear a weight of seven hundred pounds without sustaining the least injury. From this shelly covering the animal cannot disengage itself; but within it he is safe from almost any enemy but man. Living wholly on vegetable food, it is a harmless creature, if left undisturbed.

The vital energy of these animals is remarkable. Several have been known to live from eighty to one hundred and twenty years, and one is mentioned that survived upwards of two hundred years. As for killing them, it cannot easily be done. Goldsmith states that Redi, an Italian philosopher, took a land tortoise, made

a large opening in his skull, and drew out all the brain, washed the cavity, so as not to leave the smallest part remaining, and then, leaving the hole open, set the animal at liberty. Notwithstanding this, the tortoise walked away without seeming to have received the smallest injury, only it shut the eyes, and never opened them afterwards. In a few days the aperture was overgrown with skin, and the animal lived on without brain for six months, walking about unconcernedly, and using its limbs as before. Not satisfied with this experiment, Redi carried it further, and cut off the head, and the tortoise lived for twenty-three days after its separation from the body. The head also continued to rattle the jaws, like a pair of castanets, for above a quarter of an hour.

This class of creatures have a peculiar arrangement for the circulation of their blood. Though they have lungs, the blood, instead of passing through them, as in warm-blooded animals, goes directly to the arteries, which send it through the frame. Hence they are able to live for a considerable time without breathing, and thus to remain under water without the slightest inconvenience. And in view of such facts, who but must devoutly admire the wisdom that has contrived such a variety of organized existences, and so marvellously adapted them to the peculiarities of their diversified habitations?

Ophidians, or Serpents. This tribe includes some three hundred species; all of these cast off their skins

periodically, and in colder latitudes are torpid during winter. Their habits are thoroughly predacious,—insects, frogs, birds and beasts become their prey; and which they swallow whole, leaving neither skin, nor bone, nor scale of their victims upon the face of nature. The mechanism of the mouth of these animals is so contrived, and the pieces that form it so put together, as to enable them to twist and distort and dilate it so enormously, that they can swallow animals bigger than their own bodies.

The *Boa Constrictor* is a most formidable reptile, and has frequently been found thirty-five feet, and even forty feet long, and as thick as a man's body. This monster lurks in the dense recesses of tropical forests, where, when prompted by hunger, it preys on every animal that comes within its reach. Coiled round the boughs of trees, it has darted on the unwary traveller passing beneath, and after crushing him into a mummy in its terrible folds, gorged him at a mouthful. In the same way, and with equal facility, it has attacked and killed the strongest animals, and then swallowed them whole. These unconscionable repasts are followed by torpor, and the unwieldy animal, buried in some inaccessible lair, there digests its meal; and at length awakes again at the calls of hunger. Thus prompted it glides cautiously forth, and every beast of the forest that is able flies at its approach. The great *Liboya* is said to be the largest species now in existence, of which Legant saw one in Java that measured fifty feet long.

Though serpents possess neither feet, nor fins, nor wings, yet few animals are so nimble, or can transport themselves from place to place with equal grace and agility. Whether to seize their prey, or to escape from danger, many of them move with the rapidity of an arrow; they emulate, and even surpass many birds in the ease and swiftness with which they gain the tops of the highest trees; twisting and untwisting their flexible bodies around their trunks and branches with such celerity that the sharpest eye can scarcely follow their rapid motion. The black snake, it is said, will glide over the face of the earth almost as fast as a horse can gallop, and can also climb trees with the utmost agility.

Serpents give many indications of superior instincts and sensations. They have always been an emblem of cunning; the Egyptians used the serpent in their hieroglyphics as a symbol of wisdom. They wait with amazing patience, and almost absolutely motionless, the favorable moment for seizing their prey. Towards assailants, they often manifest violent rage and fearless courage; while, on the other hand, they are capable of being so tamed as to show strong signs of attachment to their masters. Some species are said to be susceptible to the charms of music, and will crawl out of their hiding-places to listen to it.

Their tenacity of life is remarkable. They can go for months together without food; a viper can live a year without any nourishment; and M. Audubon had

a rattle-snake in a cage, which for three years refused all food. They can bear to be frozen and thawed alternately without extinguishing life, or injuring any of the functional powers. They have been found with food in their stomachs frozen, and not digested; but when exposed to heat, they revived, and digestion commenced and continued till all the food disappeared, as if nothing had happened.

Of all the serpentine family, some twenty-six species only are poisonous; of these the viper, the hooded snake, and the rattlesnake are the most deadly. The venomous fangs of these animals present the most striking exhibitions of mechanical contrivance in all animated nature. The purpose of the Creator in calling into existence animals so malignant, and endowing them with powers so deadly, is a question involved in much darkness and difficulty. On this recondite subject we can only say that, from the benevolence which pervades the general designs of creation we ought also to presume that, if we fully understood all the ends accomplished in the economy of nature by these venomous reptiles, we should see and acknowledge that God was as wise and good in their creation as in that of any other animated beings.

Rattlesnakes are viviparous. When their young apprehend danger, they run, like the little chickens, to their best protector; and the method nature has provided for their safety is most singular, for the mother opens her mouth and swallows them alive, and

returns them again when danger is over. Of this fact M. de Beauvois says he was an eye-witness.

Batrachians, or Frogs. Of these one hundred and seventy-five species have been enumerated. The form and habits of the frog are too familiar to need description; the history of its production, however, is full of interest. The germ of its existence is a diminutive egg floating in the water; this gradually becomes a living, moving globule, which, in due process of time, is transformed into a tadpole; in the course of a few weeks this again puts forth four legs, and now wears the appearance of a lizard; after a short period longer, the tail drops off, and, all the necessary changes of constitution being completed, the animal emerges from the water, and begins a new mode of existence, having become a perfect frog. Thus this despised little creature passes through three separate modes of existence. How marvellous are the plans and processes pursued in the production of the humblest of Nature's works.

Nearly related to the frog is the *Toad*. In form it is very much like the frog, and is equally harmless. That called Pipa, and found in Surinam, brings up its young something like the opossum. On the back of the female are certain cavities, like the cells of a bee. When she lays her eggs, the male gathers them together, about seventy-five in number, and places them carefully in these hiding-places, which then close over them; in about three months they are hatched, and come out in miniature, just like the parent.

Some persons entertain a special aversion to toads, and make a practice of ill-treating or killing them whenever they chance to cross their path, because, as they say, "They are so ugly." And frogs, by reason of their close resemblance, being mistaken for them, are frequently subjected to similar cruel treatment. Such conduct assuredly evinces a shocking disregard of the sacred rights of sentient creatures. So ugly! That God's creatures should seem ugly to us, when every thing in nature is good and admirable after its kind, is one of our own imperfections; each toad, each crawling worm, each living atom, is the product of infinite and unerring skill; and instead of wickedly maiming or massacring what we are too ignorant to admire, and, perhaps, too indolent to study, it should be a lesson of humility to us that we cannot see with more discerning minds. Even the toad has his excellences; to name no more, his eye is a living gem of beauty. To condemn and hate the form in which these little animals, or any others, have been made, is nothing less than to reproach their Maker; and to lacerate and destroy them simply because they are not conformable to our notions of beauty, is no other than vicious cruelty. Go on, poor toad! go on thy way, there is room enough in the world both for me and for thee.

VERMES, or Worms. This is a very numerous family, and embraces over eight hundred species. These present us with almost every imaginable form, organiza-

tion, and habit. Some are naked, and some are encased; some have heads and eyes and antennæ, and some have none of these; some are formed with mouths, and some are furnished with probosces; some live in the water, and some in the soil; yet the structure and senses of every species, as far as studied, appear marvellously adapted to its particular place and mode of existence.

The common Earthworm, though despised and often trampled upon by the ignorant and thoughtless, is found by the man of science a subject full of interesting wonders. Its blood circulates without the intervention of a heart, and its nervous system exhibits features peculiar to itself. Along its back is a row of one hundred and twenty apertures, opening between the segments of the body, for the purpose of respiration. If this worm be cut in two, each part in a short time will become a perfect and complete worm, like the original. And if each of these be divided again in like manner, the same result will follow. The little worm called *Nais* has been divided into twenty-six parts, and nearly all of them produced the head and tail, and became so many distinct individuals. Add to all this, the earthworms serve very important ends in the economy of nature, although their labors are generally overlooked. They are nature's ploughmen. They bore the stubborn soil in every direction, and render it pervious to the air, to the rain, and to the fibres of plants and grasses. Without these auxiliaries,

the farmer would find his land cold, hard-bound, and unproductive. The green mantle of vegetation which covers the earth is dependent in no small degree upon the worms which burrow among its roots, and enrich them with their refuse, and finally with their own bodies.

Another class of worms possessing great interest, and that have enlisted much study, are those called *Entozoa*, or parasites. These inhabit the bodies of living animals, including man himself. Many hundred species of them have been detected and described. "It is a notorious fact," says Watson, in his Medical Lectures, "that numerous parasites do crawl over our surface, burrow beneath our skin, nestle in our entrails, and riot and propagate their kind in every corner of our frame. Nearly a score of animals belonging to the interior of the human body have been already discovered and described; and there is scarcely a tissue or an organ but is occasionally profaned by their inroads." They have been found, not only in the intestines, but in the muscles, in the liver, in the kidneys, floating in the blood, buried in the substance of the heart and brain, and even within the ball of the eye. These, assuredly, are facts sufficient to humble the foolish pride of man. How true, how literally correct, the words of afflicted Job, "I have said to corruption, Thou art my father; and to the worm, Thou art my mother and my sister: my flesh is clothed with worms and clods of the dust."

REFLECTIONS.

In the forty-first chapter of Job, the Crocodile, under the name *Leviathan*, is pointed out and described as a specimen of the Creator's power and authority, and as serving to abate the pride and humble the haughtiness of mortals. And when, in comparison with man, we consider this reptile's vast dimensions, its enormous voracity and strength, its fleetness in swimming, its daring impetuosity, its frightful mouth and impenetrable scales, it is well calculated to inspire terror and to humble man, while it displays and magnifies the power of Him who created it. Yet geologists, as noticed in the early part of the work, tell us, and their statements are confirmed by visible proof, that even the crocodile and the gavial are but pigmies compared with the race of Saurians that occupied the surface of our globe far back in the pre-Adamite periods of its history, when, says Hugh Miller, "there were lizards bulkier than elephants; reptilian whales furnished with necks slim and long as the bodies of great snakes; flying dragons, whose spread of wing greatly more than doubled that of the largest bird." While we stand in awe as we contemplate such appalling monsters, we cannot but feel a glow of thankfulness that their number, range, and magnitude have now been reduced to a point consistent with human safety.

The serpent race stands in interesting but painful association with the history and destiny of man, as the

instrument of his fall in Eden. Sin, the Scripture informs us, had entered the universe before the creation of man. A great number of the exalted spiritual beings that surrounded the eternal throne, at some dateless period, had revolted and swerved from their allegiance to JEHOVAH, under the guidance of one particular leader, called Satan. And this fallen archangel, now wicked and depraved, not content with the ruin of himself and associates, desired and sought the ruin of the newly-created *man* likewise. And for the more successful accomplishment of his malicious design, he employed the agency of a *serpent*. To us, at this day, this creature, a loathsome reptile, may appear a most unsuitable instrument for this purpose. But we must remember that the Scripture teaches us that the serpent is not *now* what it *then was*. It is now in a form and in a state of degradation. This is a point of interest. The Hebrew name given to the serpent in this place is *nahash*, a term signifying discernment, sagacity. The original name, therefore, of this creature, plainly indicates one of more than ordinary intellect, and not a stupid reptile. And the sacred narrative expressly states, that the creature here intended stood at the head of the animal creation, and was the most subtle or sagacious of all the beasts which the Lord God had made. We have, therefore, grounds to believe that this animal was not of its present serpentine character before the fall of man. But immediately after that sad event, and in consequence of its instrumental

connection with it, and for a *memento* to man of his own fall and depravation, it was transformed and degraded into such a reptile as we now behold it. In the beginning, it stood chief among the brute creation, but from the day of man's fall it became a vile and creeping thing. "Upon thy belly shalt thou go, and dust shalt thou eat all the days of thy life." Accordingly, we find that it was a common belief among the ancient Jews and the early Christians that the serpent, before the fall, was not only gentle and innocuous, but in form and appearance among the most beautiful of creatures. The serpent, therefore, being thus at the head of the animal creation, and making the nearest approach to man in intelligence, was the most suitable to be made the vehicle of the designs and assault of Satan. We have no evidence, indeed, that this creature ever possessed the faculty of speech; but as Balaam's ass, under the influence of superior power, was enabled to speak with human voice, so it may be that the serpent was for the time gifted with vocal power, under the influence of this fallen archangel. Or, whatever else the true explanation of this may be, the fact that words proceeded out of the mouth of the *nahash* is certain, for God hath said it. The words and reasoning addressed to Eve, however, were in reality the words and reasoning of Satan, who had entered the serpent, that is, they were the produce of Satan's intellect. In the crawling serpent, then, we have a perpetual remembrancer, even to the end of

time, that we are the fallen offspring of a fallen parent.

No creature of God has been made in vain. All His works, from the highest to the lowest, have been formed in wisdom, and for worthy ends. The foregoing class of animated nature, however, have been shunned and hated, rather than studied and admired by the generality of mankind. But the hasty glance we have now taken plainly shows, that crawling reptiles bear the impress of the Divine Hand, and that His goodness extendeth even to these. Even the worm has his place to fill, and his part to perform, in the great system, and is neither forgotten nor overlooked by the Great Father of all. "I wish to impress upon your minds," said Dr. Mason Good to his students, "by the incontrovertible facts of living examples, that nothing is low, nothing is little, nothing in itself unworthy, in the view of the Creator and common Parent of the universe; that nothing lies beyond the reach of His benevolence, or the shadow of His protection. God alike supplies the wants, and ministers to the enjoyment of every living creature; He alike finds them food in rocks and in wildernesses, in the bowels of the earth, and in the depths of the ocean. His is the wisdom that to different kinds, and in different ways, has adapted different habits and modes of being; and has powerfully endowed with instinct where He has strikingly restrained in intelligence. It is He that has given cunning where cunning is found

necessary, and wariness where caution is demanded; that has furnished with rapidity of foot, or fin, or wing, where such qualities appear expedient; and where might is of moment, has afforded proofs of a might the most terrible and irresistible." *His mercy is over all His works; and all His works praise Him.*

II.

The Sixth Day.

Man is made in the likeness and image of God.

II.

THE SIXTH DAY.

GENESIS 1 : 26–31.—And God said, Let us make man in our image, after our likeness; and let them have dominion over the fish of the sea, and over the fowl of the air, and over the cattle, and over all the earth, and over every creeping thing that creepeth upon the earth. So God created man in his own image, in the image of God created He him; male and female created He them. And God blessed them, and God said unto them, Be fruitful, and multiply, and replenish the earth, and subdue it; and have dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moveth upon the earth. And God said, Behold, I have given you every herb bearing seed, which is upon the face of all the earth, and every tree, in which is the fruit of a tree yielding seed; to you it shall be for meat. And to every beast of the earth, and to every fowl of the air, and to every thing that creepeth upon the earth, wherein there is life, I have given every green herb for meat: and it was so. And God saw every thing that He had made, and, behold, it was very good. And the evening and the morning were the sixth day.

MAN.

DAY by day, and from stage to stage, we have traced the progressive work of creation, till we are now arrived near its close. All that we have thus far surveyed, however, has been but preparatory work—but the fitting up of a mansion for an expected occupant—but the erecting of a temple for a coming worshipper. And now at length that the mansion is finished, the temple with all its furniture completed, the long-looked-for occupant and worshipper only remains to be created.

It will be observed, that in opening the account of man's creation, the sacred history assumes a different and loftier phraseology, and becomes invested with peculiar solemnity; thus conveying a plain intimation of his pre-eminent distinction above all that went before. The creative fiat now takes a marked change. Hitherto it had been said, Let there be light, Let the waters be gathered, Let the earth bring forth, etc.; but it is not said, Let there be *man*. The Creator himself is now described as coming forth from his hiding-place. To denote the superior nature and high destiny of the being about to be formed, the ELOHIM is represented as proceeding to the work with measured deliberation, and as the result of self-consultation. *And God said, Let us make man in our image, after our likeness.* And to indicate the direct and peculiar derivation of the creature man, he is described as formed by the immediate hand of God, and animated by his breath. *And the Lord God formed man of the dust of the ground, and breathed into his nostrils the breath of life, and man became a living soul.*

The language used in this place is peculiar, and worthy of note. "Let *us* make man, in *our* image, after *our* likeness." The original for "God" is Elohim, a plural noun, yet used with the verb "created" in the singular. "And what is remarkable, throughout the Bible," says Cummings, "Elohim, plural Hebrew, is used with a singular verb"—a fact which Jewish Rabbies, as well as many Christian Divines, regard as indi-

cating the great truth of THREE PERSONS IN ONE GODHEAD. Thus the Father, the Son, and the Holy Ghost are represented as united both in the *creation* and in the *redemption* of man.

"Let us make man in our *image*, after our *likeness*." This image and likeness consisted not in figure and lineaments of body, for God is a Spirit, and no material form can bear any similitude to Him. This image lay in the soul, and consisted in its capacities to resemble God in his moral attributes—in a mind capable of true knowledge, a conscience to distinguish between right and wrong, affections to delight in holiness, and a heart to love God with all its powers. In *love* was this image perfected, for God is Love.

"And let them have *dominion*." This power or dominion was given to man on the ground of his pre-eminence, or because he intellectually and morally bore the image of God. In virtue of this delegated authority or dominion, it is probable that Adam's control over the animal creation was much more complete before the fall, than it has been since among his descendants. Prof. Bush, in his notes, supposes that "in consequence of Adam's transgression, this lordship was in a great measure forfeited, and *his* rebellion against God punished by the rebellion of the creatures against himself."

"*Male* and *female* created He them." This expression is anticipatory of the next chapter, and simply signifies that the race of man was to be constituted male and female.

"And God *blessed* them,"—that is, gave them power to propagate and multiply upon the face of the earth. In virtue of this blessing of fecundity, the earth has been replenished with inhabitants through all the ages. "Of *this* one blood God hath made all nations of men to dwell upon the face of the whole earth." Its present population is estimated at 1,200,000,000. And it has been computed that the total number of human beings that have existed upon our globe since the creation amounts to no less than 36,627,843,275,000,000. Exactness, of course, in such a calculation, is not to be obtained or expected, and the above figures can be regarded only as an approximation to the truth. Still, they serve as a striking illustration of the propagating blessing bestowed upon man at his creation.

"Behold I have given you every herb bearing seed," —that is, all the cereal plants, such as wheat, corn, rye, etc., whose peculiar distinction and characteristic it is to produce seed; "and every tree in the which is the fruit of a tree yielding seed; to you it shall be for meat." In these words, God assigns, and points out to the newly-created man, the food most suitable for him. It was plainly intended that he should subsist on vegetable food—herbs, grains, and fruits. These only were allowed to and used by man in his first estate. This abstinence from animal food is preserved in the traditions of all nations, as one of the characteristics of their golden age, or the age of innocence.

"And to every beast of the earth, and to every fowl

of the air, and to every creeping thing that creepeth upon the earth, wherein there is life, I have given every green herb for meat,"—that is, all grasses and succulent plants, whose nutritious qualities reside chiefly in the stems and foliage. Through all the generations and varieties of animals, from the ponderous elephant to the invisible mite, no living thing can subsist without food. And we see the goodness of God, in making suitable and ample provision to meet the wants of all, ere He formed and called them into existence. And unto this day, it is strictly true, "These all wait upon Thee, that Thou mayest give them their meat in due season. That Thou givest them they gather; Thou openest Thine hand, and they are filled with good."

"And God saw every thing that He had made, and, behold, it was very good." This is the Divine testimony respecting the works of creation, when all was finished. All was good, supremely good, and only good. Whatever of evil or disorder there may be now in the world, these formed no part of the original plan and work of God, but have been introduced in consequence of man's transgression.

MAN.

In the image of God created He him.

HIS BODILY FRAME

Man is the crowning work of creation, both as to his bodily organization and mental endowments. Physiologists have pointed out numerous particulars in which man differs from, and surpasses, the highest and most perfect of all terrestrial animals. The first and most obvious of these distinctions is his *erect posture.* Man is made to walk uprightly, and "he presents the only instance among *Mammalia* of a conformation by which the erect posture can be permanently maintained, and in which the office of supporting the trunk of the body is confined exclusively to the lower extremities." This is the natural position for him, and the best suited to his organization and habits. He could not, even if he wished, go for any length of time on all-fours; for in that position, the action of the heart, and consequently the whole circulation of the blood, would become deranged; the head, sustained as it is by a small and slender muscle, would drop; the eyes would become fixed on the ground, and of little use; and the movements of the whole frame would become slow and difficult, and ludicrously grotesque. On the other hand, in his vertical attitude, man presents a symmetrical and commanding form; his movements all are easy and natural; the head sits lightly and gracefully

upon the shoulders, the expressive features of the countenance are displayed, the eyes have a wide and uninterrupted sphere of vision, and, altogether, he displays a beauty of figure, and nobleness of aspect, that stamp him as the lord and master of this lower creation. Well, therefore, might Cicero have exclaimed, "How many excellences has God bestowed on mankind! He has raised them from the ground, and made them lofty and erect, that, with an eye directed to heaven, they might aspire to the knowledge of the Divine character."

Throughout the domain of animated nature, not a living thing can be found that comes near the *creature man* in external symmetry or beauty of features. Nothing, merely animal, resembles the varied expression of the human eye; nothing approaches the charm of the human smile; nothing can be compared to the expressive features of his intellectual countenance.

Another point of high superiority in the human frame over all other beings is his *Skin*. The complexion, the delicacy, and the softness of this are without a parallel in the animal kingdom. But apart from all that delights the eye, the taste, and the touch, the skin, through its exquisite nervous sensibility, is a medium of great and important mental advantages. To it we owe a large portion of our sensations and ideas. It constitutes a channel of ceaseless communication between the indwelling mind and material things without. A fine nervous expansion, proceeding from

the brain, is most admirably spread over the outside of our bodies, immediately under the cuticle, which is ever alive to every external impression, whether of pleasure or of pain; and these impressions are often closely connected with our moral feelings, and with our best sympathies. "No small portion of the tenderness of our nature, and of our compassionate benevolences," says Sharon Turner, "are related to the skin. With the hide of a rhinoceros, or the wool of a sheep, or the shaggy coat of a bear, we should not possess the feelings of a human heart, nor the intellectual sensibility of a cultivated mind. A comparative stupidity, hardness of nature, insensibility, roughness, cruelty, or savage humor, would characterize us in such a transformation, as corresponding qualities accompany other creatures, according as their outside habiſament differs from our beautiful exterior."

The chief and distinguishing superiority in the human frame is the *Hand*. The hand belongs to man exclusively. The same system, essentially, of bones and muscles that constitute his arm and hand belongs, indeed, to the higher division of the animal kingdom—*Animalia vertebrata*—which includes the whole chain of beings from man to fishes. But in these, those bones and muscles are modified and developed to suit the nature and circumstances of each particular race; in the fish, they are fashioned and adjusted to form a *fin;* in the bird, a *wing;* in the lion, a *paw;* in the horse, a compact foot encased in a *hoof*. Admirable,

indeed, are all these in their adaptations to the wants of their several owners; but had this system of parts, this limb, attained no better or more perfect form than either of these in man, where had been his present elevation? where his arts, his science, his supremacy? In that case, as Galen, centuries ago, observed, "he would no longer work as an artificer, nor protect himself with a breastplate, nor fashion a sword or spear, nor invent a bridle to mount the horse and hunt the lion. Neither could he follow the arts of peace, construct the pipe and lyre, build houses, erect altars, inscribe laws, and through letters hold communion with the wisdom of antiquity." The armed fore-extremities of a variety of animals give them great advantages; but these advantages all, and far more, are secured to man in a *Hand*, with reason to use it. "The human hand is so beautifully formed," says Sir Charles Bell, "it has so fine a sensibility, that sensibility governs its motions so correctly, every effort of the will is answered so instantly, as if the hand itself were the seat of that will; its actions are so powerful, so free, and yet so delicate, that it seems to possess a quality instinct in itself, and there is no thought of its complexity as an instrument, or of the relations which make it subservient to the mind; we use it as we draw our breath, unconsciously; its very perfection makes us insensible to its use." The arm and hand, considered in their mechanism alone, are structures of unrivaled excellence; and, when viewed in relation

to the intellectual energies, to which they are subservient, plainly reveal to us the Divine Source, from which have emanated this exquisite workmanship and these admirable adjustments, so fitted to excite in our breast the deepest veneration, and to fill us with never-ceasing wonder and gratitude.

Man stands at the summit of the animal pyramid. He not only combines in himself the excellences of all the higher order of animal organizations, but those excellences in a far higher degree. Man seems to have been the archetype set before the Creator's mind from the dawn of vertebrated existences, and toward which He thought fit to work upward through the vast pre-Adamite periods, producing in tribe after tribe a higher and still higher degree of symmetry and perfection, till man, the master-piece, was brought forth. "From the past history of our globe," says Prof. Owen, "we learn that Nature has advanced with slow and stately steps, guided by the archetypal light amid the wreck of worlds, from the first embodiment of the vertebrate idea, under its old ichthyic vestment, until it became arranged in the glorious garb of the human form."

In the 139th Psalm, the formation of the human body is described under the metaphor of a piece of beautiful embroidery—"When I was formed in secret; when I was wrought as with a needle in the lowest parts of the earth."* The figure is equally elegant and expressive. The frame upon which this living

* Lowth's Translation.

embroidery is wrought, is made up of no less than two hundred and forty-five bones of various forms and sizes; each of which is carved, and turned, and grooved with exquisite skill to fit its place, and perform its functions; whilst all are jointed, and hinged, and bound together into one complete and marvellous skeleton. To these bones, and to other parts of the system, are attached, for the purpose of motion, over five hundred muscles, some large and strong, some diminutive and of the utmost delicacy, some obeying the mandates of the will, and some acting spontaneously. These muscles are often so closely contiguous to one another that they are found in layers, as it were, over one another, crossing one another, sometimes imbedded in one another, sometimes perforating one another; yet all so perfectly arranged that they never obstruct one another, or in anywise interfere. Within the frame-work, and protected on every side, are planted the essential organs of life—the Brain, the Heart, and the Lungs—all in unceasing action from the beginning of life to its close. Enclosed within the system are also those of digestion, and nutrition; the stomach with its gastric chemistry, and the bowels with their myriads of lacteals collecting nutriment. Through the whole body runs a perfect network of veins, arteries, and nerves, each dividing into countless ramifications, penetrating every part, and diffusing life and sensibility throughout the entire frame. Over many of the internal parts and delicate organs are woven membranous veils, or vital tracery, too marvel-

lous for description; while externally the whole is mantled from head to foot with a threefold skin, perforated with its millions on millions of pores for the purpose of perspiration.

So finely articulated are the various members, and so close the connection, and so perfect the harmony, of the muscular and nervous systems that, every joint is instantly ready for any movement or action that the mind may require. Of all this we have notable examples in the act of writing, and in that of executing a piece of music on the piano; in either of these performances, how numerous the muscles brought into play, and yet how happily measured, how definite and perfect and rapid their action! But if the voluntary operations of man excite wonder, those that are *involuntary*, and carried on without conscious effort or care on his part, ought, assuredly, to awaken his profoundest gratitude and devotion, especially when he remembers that these are indispensable to his life. The heart ceaselessly expands and contracts, the lungs play, the stomach digests, the glands secrete; and all this surprising mechanism and chemistry proceed with such quietness, and are so self-sustained, that neither does sleep stop them, nor is our repose disturbed by them. If these vital operations had been dependent on the superintendence of the mind, man's attention could not have been diverted from them for a minute; all his care must have been concentrated on the working of his bodily organs, and all his care would still have

been insufficient; for a doubt, a moment's hesitation, a forgetfulness of a single action at its appointed time, would have terminated his existence. His life in such a case would have been most precarious, and most unhappy,—every breath would have been drawn with fear, and every pulsation would have been attended with painful anxiety. Here, then, we behold the wisdom and goodness of God in thus Himself holding our souls in life.

"What a miracle of creation is man! How fearfully and wonderfully made—a monument reared by Infinite Wisdom—a prodigy of parts! Could the unrivalled mechanism of man be unveiled, or its thousand movements be seen through a *transparent medium*, what a scene for contemplation, wonder, and astonishment; and what a medium for adoration of the Great and Eternal Creator, who made and adjusted the mechanism, and put all its parts and powers in motion!

"What a vision it would be to see the ganglia shooting their electric influences along the lines of the nerves—the pneumatic machinery of the lungs discharging the envenomed air, and receiving in exchange a supply of a pure medium! The pause and interval in respiration, to divide the gases agreeably to their relative specific gravities. The hydraulic engine of the heart propelling the vital fluid of the blood; its contractions and dilatations; the flapping of the mitral, semilunar and tricuspid valves, acting like the valves of a steam engine; the vibrations of the muscles; the

pulling of the cordage of the tendons; the synovial or lubricating secretions of the joints, and their balls, and their sockets; the chronometry of the pulse, and the calorimeter which measures out heat to the system, and apportions its quantity according to circumstances, —a principle of compensation to equalize the temperature, and preserve an equilibrium under all changes and every variability. The absorbing vessels sucking up the several assimilated materials with a skilful selection, and with rare discrimination appropriating all; the functions of the skin cooling the surface when required, and the orifices acting as the waste pipes also of the system. The optical wonders of that perfect achromatic instrument, the eye; its window, and its curious curtain, and its lens, and the media in contact with it; its reticular canvass in the back-ground of a camera obscura, with all its microscopic and telescopic furniture. The acoustic paraphernalia of the ear, with its hammer, its stirrup, and its drum, and its chambers, and its beautifully convoluted recesses. The movements of the brain and its membranes—the secreting and assimilating organs engaged in recruiting the waste, and rearing the goodly structure; the sensitive, irritable, and jealous epiglottis, guarding, like a faithful sentinel, the viaduct of the trachea; the refined sensibility of the papillæ and fibrillæ of the tongue, and the delicate functions of the sneiderian membrane. These, and myriads more of secreting and assimilating organs, with the secretions of the kidneys, mammæ, gall-

bladder, salivary glands; pancreas, conglobated glands and lacteals, may well demand our wonder and admiration. What a miracle of skill and complication, and yet how calm and unobtrusive their harmony! All that is beautiful in design, and wonderful in the adaptation of parts, with their mutual aptitudes, are here concentrated in one luminous focus of Almighty Wisdom."—*Murray's Truth of Revelation Demonstrated, p.* 32.

Another fact that heightens unspeakably our admiration of the human body is *the method in which it is kept in repair.* While all the above complicated machinery is in full operation, its every member, every organ, every vessel, every fibre, is removed and replaced by another and a new one, without occasioning one moment's interruption of its movements. This is effected through the processes of nutrition and assimilation. Old and worn-out particles of the system are being continually carried away by perspiration, respiration, etc.; and these are constantly replaced by new particles derived from the food we eat and the air we inhale. Thus the whole fabric is dissipated probably in the course of a few months, certainly in a very few years; so that our present frames are no more identical with the frames of our early youth, than they are with those of our grandfathers. The houses we inhabit, so to speak, are pulled down stone by stone, and yet rebuilt as fast as they are destroyed; all their furniture and fixtures are severally removed and replaced, par-

ticle by particle. The whole of each edifice is reconstructed in the course of a brief period, and yet no eye can follow the process, or detect any organic change in the architecture of the pile. Though the vital artificers are constantly at work, their operations are wholly unfelt; we are never conscious of the separation of particles, or of the substitution of others. And still more striking is the fact that, the very organs that are kept in constant activity are themselves silently renewed without interrupting their functions for an instant. The whole substance of the lungs is removed and replaced without the suspension of a breath. The heart is reproduced out of our food without losing a single beat, and without spilling a drop of blood. The eye is taken to pieces, time after time, and the windows of vision reglazed, without disturbing our sight for a moment, or obscuring the minutest object at which we may desire to look. And new stomachs are repeatedly inserted in our bodies, without our ever being compelled to stop eating and suspend digestion until the apparatus can be properly replaced. That the human body, with all its inward motions and outward activity, should be disintegrated, removed, and rebuilt, in this manner, is surely as great a marvel as if a manufactory with all its hundreds of wheels, scores of looms, and thousands of spindles, should be renewed from top to bottom, from year to year, without once turning off the steam of the engine, or slackening the speed of a wheel, or interrupting the flight of a shuttle, or even

attracting for once the attention of an operative. Here, then, assuredly, every reflecting and thoughtful man must lift up his heart and voice with the pious Psalmist, and say, "O Lord, I will praise Thee, for I am fearfully and wonderfully made."

HIS INTELLECTUAL POWERS.

The foregoing bodily structure, wonderful as it is, is but the tent of an invisible tenant, the *Spirit* given by the inspiration of the Creator; and all its marvellous parts and organisms are but the tools and instruments provided for the use of that spirit. In the employment of this immortal mind all this sensitive apparatus finds its appropriate use, and its highest end fulfilled. All the marvels of its intricate and beautiful mechanism are of value only in the service of the soul. As *he*, therefore, who occupies the house is more honorable than the house, so this spirit of man is of a far nobler nature, and presents infinitely loftier displays of creative wisdom and power, than the body which it inhabits.

In man, the mind or spirit is the seat of the intellectual faculties; and the special dwelling place of that mind is the brain. Here, in the silent recesses of the brow, it holds its court, and maintains in ceaseless activity all the noble and marvellous powers of its being;—here it employs its ever-active Reflection; here Reason conducts its labored processes; here Memory lays up its treasures of observation and experience;

here Imagination spreads her airy wings, and Genius creates her teeming wonders. From beneath the dome of this sacred temple the immortal spirit looks up, adoring, to the Great and Glorious God, from whom it has proceeded, and to whom it shall return.

From the brain, the Mind's habitation, proceed nerves to every organ, and to every portion of the system; these nerves are found to be double, or composed of two threads closely wrapped together; along the one, as by telegraphic wire, the mind sends forth its commands of *motion* to every member and muscle; and along the other are conveyed back to the mind, in a similar manner, the *impressions*, pleasant or painful, received by any and all the organs and parts of the body. Thus the indwelling spirit is placed in sensible and perceptible communication with the external world. Through the avenues of the five senses it becomes acquainted with whatever has form, weight, color, taste, or smell. From these external objects, singly or in combination, the mind is continually taking impressions, and exercises upon them its comparing and reasoning powers, and thence deduces its ideas of unity and number; of time and space; of order, proportion, and similitude; of truth, wisdom, power, obligation, succession, cause, effect, etc. Thus the indwelling mind proceeds in its observation from object to object, and scene to scene; and by comparison, analysis, and combination of these, ever advances to new ideas, new inferences, and new conclusions. "The

mind has a class of powers which thus elaborate the materials or facts acquired into an infinite variety of cognitions and judgments. Nor is there a greater difference between the flax in its raw state, and the fine linen of exquisite pattern constructed from it; between the stone when taken from the quarry, and the marble statue into which it is wrought,—than there is between man's primary knowledge through the senses and the consciousness, and those lofty comparisons, and refined abstractions, and linked ratiocinations, which he is able to construct by his higher intellectual faculties." *

All this mental activity, however, would avail but little, if the mind did not possess the power of *retaining* the acquisitions thus made; for, in that case, former impressions would perpetually yield to those coming after, and be thereby as rapidly effaced as acquired. Increase in knowledge and wisdom would be impossible. Hence the Creator has furnished the human mind with the all-important faculty of *Memory*, or the power of retaining thoughts and impressions once gained. To this faculty belong two things deserving equally our admiration and gratitude.

The simple power of retaining impressions was not sufficient; the welfare of man required that it should be the power of preserving them *beyond the immediate sphere of consciousness*—of storing them *away*, as it were, within a secret repository. This is a most

* McCosh.

important feature of Memory. If all thoughts and impressions gained were ever consciously present in the mind, ever pressing equally upon its attention, it would soon become utterly oppressed, and incapable of close reasoning, or fixed study, on any one particular subject. Consciousness would sink, and mental energy perish, under the accumulating burden. The power of storing away ideas gained beyond the sphere of consciousness is, therefore, a most wise and important provision.

Equally admirable and important is the power by which we can reproduce, or call up from this treasury, facts and truths as we need them. This power is properly called *Recollection*. But for this, the stores of memory would have remained irrevocably beyond the sphere of consciousness, and might as well have never been laid up there. But now, though they may lie dormant and latent there for months and years, they can, with greater or less facility, be quickened into living knowledge, and thus past experience be applied to present pursuits. And how admirable the *laws of association*, by which recollection is aided in bringing again before us the knowledge formerly acquired, at the very time when it is most profitable that it should return. A value is thus given to experience, which otherwise would not be worthy of the name.

To appreciate these arrangements of our mental constitution, and to see the Divine wisdom and goodness in them, we need but reflect for a moment what

manner of beings we should be if devoid of memory and recollection. Without these we should be ever learning, and yet remain equally ignorant. An object, or a truth, brought before us for the hundredth time, would be as new and strange to us as if it had never before engaged our attention. We had need every morning of a new introduction to our nearest and most familiar friends. The advantages of practice or experience would fade away as rapidly as achieved. In short, imagination cannot picture all the evils and disabilities of man destitute of memory. Life would be mere inanity; existence would not be desirable. It is the power of preserving and reproducing scenes and thoughts and feelings which have passed away, that gives value to all our other powers and susceptibilities, intellectual and moral; all science is its product, and life owes to it all its interests and joys. Its incessant operation from infancy, treasuring up the fair images of parents, brothers and sisters, and all their offices of affection and kindness, constitutes the bond that holds together families and friends. Every talent by which we excel, every vivid feeling by which we are animated, owes its force and existence to this faculty. We love and hate, we desire and fear, we seek what is good and avoid what is evil, because we remember the character, the tendency, or the properties of like objects and occurrences which we formerly observed. By memory we live the past over again; and in bestowing this gift upon us, God hath more than doubled our existence.

There is another feature of memory that specially demands our notice. It was the opinion of Lord Bacon that nothing is entirely lost from the memory which has once been given to its charge, but virtually exists, and may, under certain circumstances, be restored in all its original vividness. Many other able writers think the same. There are numerous well-attested facts that go far to support this opinion, and, perhaps, something in every individual's experience. To illustrate this—We may have spent a season in a certain locality, and then left it. Years many have rolled away since; new scenes and situations have occupied us; all we saw and felt and experienced there, appear wholly lost in the darkness of oblivion. All these years not a trace occurs to the mind. But suddenly some unexpected event, some trifling occurrence, some intonation of voice, or some darting sensation arouses the soul, and gives a wholly new and vigorous turn to its meditations, and the long-forgotten locality, with all its scenes and circumstances, is brought at once clearly before the mind. "At such a moment, we are astonished at the novel revelations that are made, the recollections that are called forth, the resurrections of withered hopes and perished sorrows, of scenes and companionships that seemed to be utterly lost."

> "Lulled in the countless chambers of the brain,
> Our thoughts are linked by many a hidden chain.
> Awake but one, and lo, what myriads rise!
> Each stamps its image as the other flies."

The power of Recollection depends much upon the state of the physical system; in certain conditions of the brain it is marvellously quickened. A servant girl in Germany, twenty-five years old, who could neither read nor write, in the paroxysms of a fever, commenced repeating fluently passages of Latin, Greek, and Hebrew, which passages, as was afterward ascertained, she had only overheard a clergyman read in the early days of her childhood. This surprising fact, and others like it, render highly probable the conclusion of Coleridge, "that all thoughts are, in themselves, imperishable." Again: the same wonderful mental activity has often been experienced at the point of drowning; persons rescued from this situation have stated that their whole past life, with its thousand minute incidents, has almost simultaneously passed before them, and been viewed as in a living panorama. Scenes and situations long gone by, and associates not seen for years, and, perhaps, buried and dissolved in the grave, came rushing in upon the field of intellectual vision in all the activity and distinctness of real existence. Have we not, then, in these astonishing facts a strong evidence that of all committed to the keeping of memory, nothing is absolutely forgotten? And are we not also here presented with a startling admonition of what will take place with each of us at the last day? The power of reminiscence may be enfeebled, may even slumber, but it does not die. At the judgment day, we have reason to apprehend, it will awake in irre-

pressible energy, and summon all deeds, all thoughts, all feelings, from their hidden recesses, and will present before us, as in a clear mirror, the whole of life, as spent among men on earth.

In the present life, memory gathers and treasures up its stores, for the most part, for the service of the intellect, and from them this faculty educes many new ideas. The reasoning power is the great fountain of internal knowledge, and the main agency of progress in every department of human pursuit. By its penetrating reflections, by its patient tracing of cause and effect, by its power of analysis and combination, by its ingenious experiments and rigorous demonstrations, has been reared the vast and ever-extending temple of science and art. Step by step, and link by link, the intellect of man has carried its calculations to the utmost depths of space and time. Its achievements, notwithstanding all the evils and disadvantages of our fallen state, are truly wonderful. It has explored and contemplated every scene and object of creation within its reach—has sounded the depths of the earth, and counted the cycles of its duration—has studied and dissected and classified the myriads of its animal and vegetable productions—has delved into the mountains, and plunged into the caverns of our globe, and inquired into the age and origin of its rocks, minerals, gems and fossils—has analyzed the invisible atmosphere, arrested the lightning in its course, and dissected the sun-beam in its descent—has invented instruments that seize the

pencil of light, and with it depict a landscape, or paint a portrait; and others that bring distant stars near, and make the moon even a familiar neighbor; and others still that reveal a world of living wonders in a drop of water, or an atom of dust—has contrived means to communicate its thoughts across seas and continents with more certainty and speed than if endowed with the voice of thunder and provided with the pinions of the eagle—has evoked a power from the limpid water surpassing that of the fabled gods, and set it to work machinery that drive his ships, draw his cars, grind his corn, weave his garments, print his books, and serve him in a thousand other ways—has, by chains of thought, and flights of demonstration, ascended the empyrean, and traced the orbits, weighed the masses, and determined the velocities of revolving worlds; "and though it has not been allowed to man to grasp with an arm of flesh the products of other worlds, or tread upon the pavement of gigantic planets, he has been enabled to scan with more than an eagle's eye, the mighty creations in the bosom of space—to march intellectually over the mosaics of sidereal systems, and to follow the adventurous Phaeton in a chariot that can never be overturned." *

To the capacity of the human mind for knowledge there seems to be hardly a limit. The progress it makes during the brief period of life is often great. What a wide interval between the mind of Newton in

* Chalmers.

his cradle, and his mind at the close of his sublime career! But the greatest attainments of man, here, afford no measure, perhaps give but a faint idea, of what he will be hereafter. As every accession of knowledge prepares the way for other and higher accessions, and as the memory will lose nothing of its garnered treasures, who can conceive what man will become in the course of future years—in the lapse of unending ages—in a state of mental vigor, and unclouded holiness? What a magnificent, what a glorious prospect, to view him advancing along the path of immortal existence, ever augmenting in capacity as he drinks from the inexhaustible fountain of knowledge and wisdom, close by the throne of God!

HIS EMOTIONAL CONSTITUTION.

Having glanced at the perceptive, retentive and reasoning powers of man, it will be in place and of interest to devote a moment to contemplate his *Emotional* nature. This is a most important department of his mental endowments. We can conceive of man being created with all the foregoing intellectual faculties, yet without any of his present emotive susceptibilities; but in that case, he would obviously have been a very different, and a very inferior being, compared with what he now is. It is our emotional capacities that impart to life all its peculiar and ever-refreshing interests. By our intellectual faculties, we are mere *spectators* of the world with its living inhabitants and

varied wonders; by our emotional powers, we are *admirers* of nature, *lovers* of men, *adorers* of God. All the progressive springs of humanity take their rise in our emotional being.

The all-wise and beneficent Creator, therefore, has constituted us with a variety of emotions; with the emotion of *alarm* to incite from danger—of *natural anger*, to make the timid brave, the weak vigorous, and the old for the moment young again, when unjustly assailed—of *complacency*, shedding cheerfulness and sunshine through the soul—of *sorrow*, diffusing its softening and chastening spirit over the mind—of *joy*, inspiring happiness, rapture and praise—of *humility*, to sink self into its appropriate obscurity—of *love*, the parent of tenderness, sympathy, friendship and affectionate attachment, and the richest and the worthiest outgoing of man's spiritual activity—of *taste*, appreciating and delighting in harmony, proportion, beauty and sublimity, and constituting the most delightful spring of refinement and elevated progress—and of *hope*, ever embellishing with bright visions the dim future, and quickening to their pursuit. Unendowed with these emotions, what would have been the character and condition of man? How blank and unbeneficent would life have been as a mere round of passionless intellectuality. Where would have been all that now makes its charm, and renders it, even amid the gathering darkness of death, still dear? Where would have been all the most exquisite produc-

tions of literature and art, without passion to portray, interest to kindle, or taste to admire? Where had been the endearments of home, and the communion of friends, without the sweet bonds of sympathy and love? In the bestowment, then, of the combined cognitive and emotive activity of our nature, we behold in a striking light both the wisdom and the goodness of God toward His creature man.

HIS MORAL NATURE.

Over all the foregoing powers and affections of man has been set, both as judge and governor, the faculty of *Conscience*, or that mental capacity by which we instantly and irresistibly feel the difference between right and wrong. This is the crowning faculty in man. Its peculiar office is to arbitrate and direct all our other powers and propensities according to rectitude, so far as that is apprehended by the understanding. Its voice is always and everywhere distinct and authoritative on the side of truth and righteousness; hence it has been denominated "the vicegerent of God in the soul of man." The authority of conscience is sacred and supreme; and it is empowered to pronounce censure and applause, and to administer rewards and punishments. It follows up every act and exercise of man with instant approbation or condemnation. If its dictates are cheerfully and implicitly obeyed, it bestows in reward the pleasure of inward complacency and self-approbation; but if its impulses are resisted or

disregarded, it inflicts the pain of a sense of guilt, or the feeling of remorse.

Though the authority of conscience is supreme, its *power* is not. The perverse force of the will may resist its commands, and the clamor and turbulence of passion may drown its voice; no amount of violence, however, can banish it from its seat in the soul. It will still hold the transgressor in its grasp, and, sooner or later, will bring him trembling before its judgment seat, even when he would seem to have broken loose from all its restraints, and completely overborne its power. Eventually it will assert its sovereignty with a fearful potency, even though its throne may have been invaded, and its sceptre for a season smitten to the ground. Nor can the offender escape its retribution; let him efface every visible stain of his guilt, and let him flee from the scene of his crimes, it will still go with him, and lay upon him its direful scourge at the distance of half the globe.

The existence of conscience within us, it has been observed, is an evidence for the righteousness of God, which keeps its ground amid all the disorders and aberrations to which human nature is liable. For, as the existence of a *regulator* in a disordered watch shows the design of its maker that its movements should harmonize with time, so conscience shows the design of our Creator that all our movements should harmonize with truth and righteousness.

It is conscience that gives to man his moral worth

and dignity; and it is this that bestows upon human life all its sacredness and moral beauty. "Apart from this," says Tulloch, "man would have been but little above the brutes around him, having no nobleness of piety in his heart, and no long-suffering love mingling its purifying fires in his lot. Conscience is a revelation of the Supreme God in man. And it brings man not only into converse with goodness, but relates him to it, as the power which binds him in his daily life, and would guide him to daily happiness."

All the faculties and affections now surveyed belong to, and reside in, the mind or immortal spirit of man. And in the first created man, as he came out of his Maker's hand, all were pure, perfect, and harmonious. Adam, as he first stood before his Creator, was a perfect man—perfect physically, mentally, and morally. Sense, intellect, affections and conscience were all in their right proportions, and in their due subordination; none deficient, none in excess. His was a perfectly sound mind in a perfectly sound body. Every emotion, passion, and propensity harmonized with conscience and with each other; while all their varied activities were but a succession of *varied pleasures*. In the whole exercise of his faculties, in all the feelings of his heart, in all his words, and in all his actions, there was a perfect conformity to the mind and will of God. And his love to that transcendently great and glorious Being was a perennial source of the most sublime and exuberant joy. And all the various displays of the

Divine wisdom, power and goodness in the scenes and objects around him, in the animate and inanimate, were illustrious sources of pleasure to his mind. Wherever his eye turned its glance, God was seen; and wherever He was seen, He was seen with inexpressible delight. The endlessly diversified forms of beauty, grandeur and glory in the new creation, were ever regarded by Him as exhibitions of infinite excellence, delighting and improving and ennobling his immortal spirit. Thus did God create man in His own image, and after His own likeness.

HIS HELP-MEET.

To complete the happiness of man God created for him an Help-meet—*male and female created He them.* The end and object of this arrangement was not only the multiplication of the species, but also the enhancement of happiness to each, by the interchange of those amiable affections, and those offices of sympathy and kindness which should arise from the inherent diversity of character in the sexes. The one was intended as the *complement* of the other: to man was given a firmer and stronger frame, and a mind more vigorous, more patient of toil, and more equal to difficulties; to woman, a more delicate and beautiful form, and gentler and lovelier affections, more refined tastes, and more tender sympathies. Thus the woman found in the man what was lacking in herself; and the man in the woman what would complete his own character; and

thus, too, each saw in the other qualities to be esteemed, admired, and loved; while the reciprocation of these tender feelings and affections served to double, and more than double the bliss of both.

To enhance and elevate the social happiness of His earthly offspring, the Creator bestowed on them one other gift of immeasurable worth and importance—the gift of *Language.* Of all the living tenants of the new-made world, speech was given to man alone, as he alone had reason to employ it; and it is impossible to estimate the advantages and the pleasure that flowed to the happy pair through this faculty. It is in itself a most striking display of the Divine wisdom that contrived it. In the wonderful system of man have been inserted two or three little organs, so exquisitely contrived, which, by a few scarcely perceptible motions, "can shape the air into sounds, which express the kinds, properties, actions and relations of things, under thousands of aspects, in forms infinitely more recondite than those in which they present themselves to his senses." *

REFLECTIONS.

What a concourse of wonders have we now seen in connection with this the last and crowning work of the Creator's hand—his erect and noble form—his expressive countenance, and hand of instinct powers—his soft and delicate skin without, and his marvellous

* Whewell.

mechanism and vital chemistry within—his admirable senses, and keen perception—his brain, the sacred temple of the soul, with its telegraphic nerves in instant and uninterrupted communication with every part—his powers of memory, reflection, reasoning and imagination—his unlimited capacity for knowledge, and the astonishing achievements of his intellect—his varied and powerful emotions, enkindling vital interest and impelling to ceaseless activity—his unslumbering conscience, God's faithful witness in the soul, always and instantly declaring in favor of truth and righteousness —and the sweet harmony of all his parts and powers and faculties with the will Divine. "How illustrious a being was man as he came from the hands of his MAKER! With what dignified attributes was he endued. For what high pursuits was he qualified. To what sublime enjoyments was he destined. In him was found, in an important sense, the *end* of this earthly system. Without man, the world, its furniture, and its inhabitants, would have existed in vain. Whatever of skill, power and goodness were displayed by the creative Hand, there was, before the formation of man, none to understand, admire, love, enjoy, or praise the Creator. The earth was clothed with beauty; the landscape unfolded its delightful scenes; the sky spread its magnificent curtains; the sun travelled in the greatness of his strength; the moon and the stars solemnly displayed the glorious wisdom of their Author, without an eye to gaze, or a heart to

contemplate. A magnificent habitation was, indeed, built and furnished; but no tenant was found. Brutes were the only beings which could enjoy at all, and their enjoyment was limited to animal gratification.

But man was separated from all earthly creatures, by being formed an intelligent being. His mind could trace the skill and glory of the Creator in the works of His hands; and, from the nature of the work, could understand, admire and adore the Workman. His thoughts could rise to God, and wander through eternity. The universe to him was a mirror, by which he saw reflected every moment, in every place, and in every form, the beauty, greatness, and excellence of Jehovah. To Him his affections and his praises rose, more sweet than the incense of the morning, and made no unhappy harmony with the loftier music of heaven. He was the priest of this great world, and offered the morning and evening sacrifice of thanksgiving for the whole earthly creation. Of this creation he was also the *lord*, the rightful, just and benevolent sovereign. The subjection of the inferior creatures to him was voluntary, and productive of nothing but order, peace and happiness. With these endowments and privileges, he was placed in Paradise, no unworthy resemblance of heaven itself; and surrounded by 'every thing which was good for food, or pleasant to the eye.' In an atmosphere impregnated with life; amid streams in which life flowed; amid fruits in which life bloomed and ripened; encircled by ever-living beauty and mag-

nificence; peaceful within; safe without; and conscious of immortality; he was destined to labor only that he might be useful and happy, and to contemplate the wonders of the universe, and worship its glorious Author, as his prime and professional employment. He was an image of the invisible God, created to be like Him in knowledge, righteousness, and holiness, His illustrious attributes; and, like Him to receive dominion over the works of His hands.

In this situation, removed far from death and disease, from sorrow and fear, he was formed for endless improvement. His mind, like that of angels, was capable of continual expansion, refinement and elevation; and his life of perpetual exaltation in worth, usefulness and honor. God was his Visitor; angels were his companions."*

We have now reached the close of the most wonderful, most interesting, and most important chapter of History in the possession of man—a chapter containing the first written discovery that God has made of Himself to mankind, and in which His eternal power and Godhead shine forth with a light of demonstration, and a sublimity of grandeur, that command the profoundest homage, and most devout adoration of all His rational creatures.

Looking back over the field surveyed in the foregoing pages; the Universe, in all its vastness and

* Dwight's Theology, Serm. xxii.

magnificence, emerging into existence; the Earth, assuming its beauty of form and garniture, and all its variety of inhabitants in sea and land and air; the attendant Moon, with its mystic motions and appalling scenery, setting forth in its ceaseless rounds; the stupendous Sun, in the greatness of his might, balancing a hundred revolving worlds, and sending forth ceaseless streams of light and heat and attractive power to guide and serve them all; and the innumerable Stars of light, centres of other systems of grandeur, all strewn through the unfathomable depths of immensity—how great and marvellous a work was that of Creation! How wonderful and glorious must be its Divine Eternal Author! What must be that MIND in which all existed in perfect and clear plan, "when as yet there was none of them!" What must be that SOURCE OF LIFE from which all intelligences, and all conscious existences, in all worlds have emanated! What must be that NATURE from which dropped, as from an overflowing exuberance, all that is good and beautiful and majestic and exalted, in the whole universe! Who can show forth His greatness? Who can utter all His mighty acts?

Holy, holy, holy, Lord God Almighty, which was, and is, and is to come! Thou art worthy to receive glory, and honor, and power; for Thou hast created all things, and for Thy pleasure they are and were created. Amen.

THE END.

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